178

THE ENGINEER

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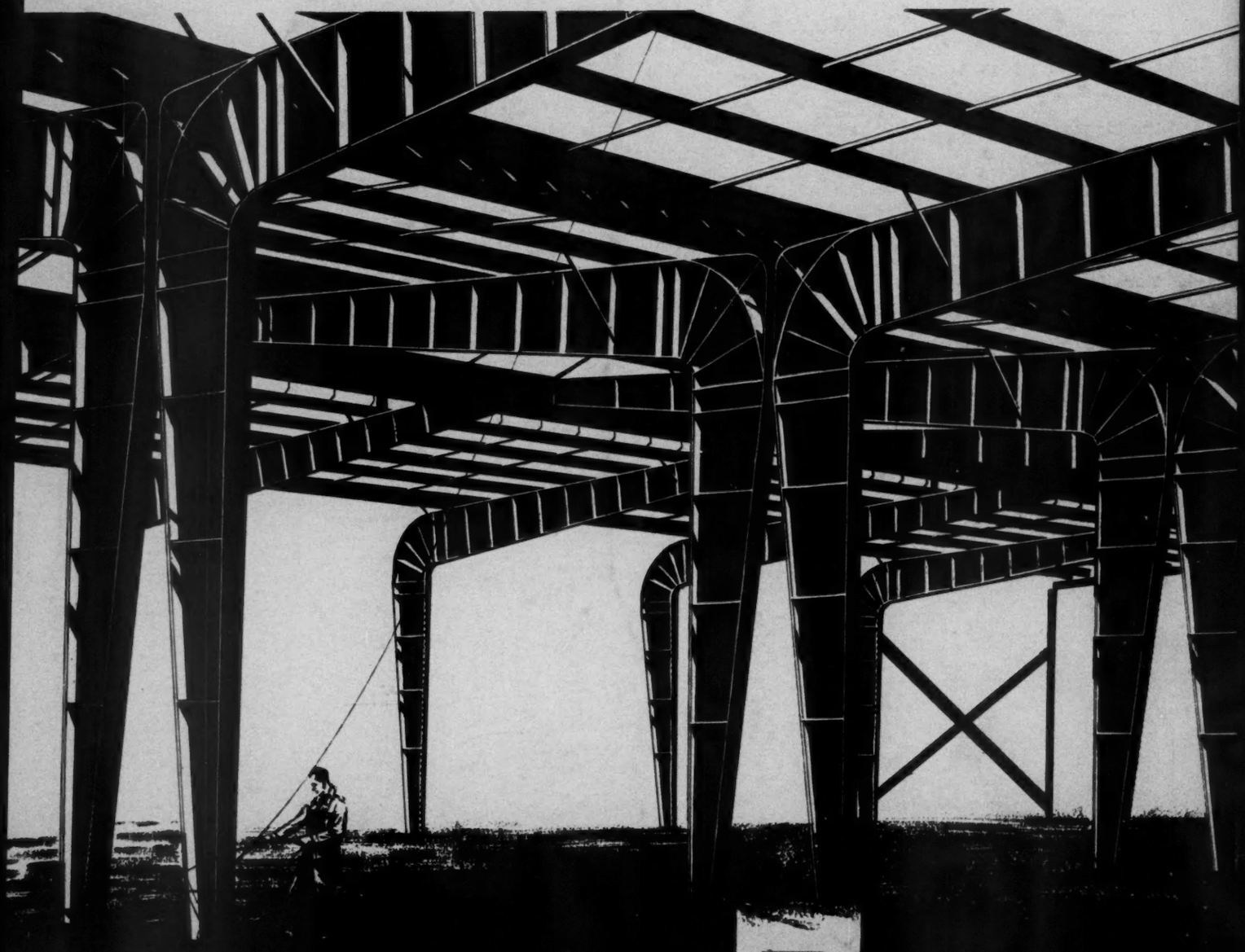

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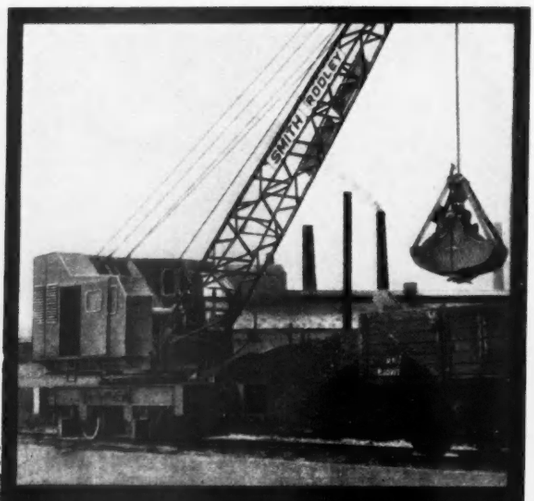

A Smith 5-ton diesel shunting crane operating a ring discharge grab to unload from railway wagons at the United Glass Bottle Co. Ltd., St. Helens.

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Established 1856

No. 5382 **MARCH 20, 1959** VOL. 207

EDITORIAL CONTENTS

Leading Articles

British Steel . . . 443
Telephone Service Proposals . . . 443
"Post-Planning" London Roads . . . 444
Too Little Too Late . . . 444
Road Taxation and the Budget . . . 445
On Ignoring Instructions . . . 445

Articles

100 Years Ago . . . 445
A. D. Somes Advances in Steam Turbines for Marine Propulsion . . . 446
Flame Hardening with Oxy-Town Gas . . . 449
Glover and Fowler Construction of 132kV Switch House at Belvedere, Kent . . . 450
Multiple Presentation Marine Radar . . . 454
Transportable Steam-Driven Power Set . . . 455
High Pressure Pumping Set . . . 459
Electrical Engineers' Exhibition. No. II . . . 460
High-Voltage Electrostatic Generator . . . 463
National Institute of Industrial Psychology Annual Report . . . 464
Education and Careers Exhibition . . . 464
Science Laboratory Technicians . . . 464
BEAMA Annual Report . . . 464
Telford Gold Medal Award . . . 464
Education for Commerce . . . 465
Newbury Relief Road Completed . . . 465
Air Conditioning of "Orcades" . . . 465
Satellites and Rockets . . . 466
Low-Temperature-Curing Anti-Friction Coatings . . . 466
Structural Steel Fabrication in Canada . . . 466
Fertiliser Plant . . . 466
Careers in Agricultural Engineering . . . 466
James Forrest Lecture . . . 466
Aircraft Seat Reservations by Computer . . . 466
Sewer Diversion at Hyde Park Corner . . . 467
Visual Transmission of Train Information . . . 467
Electrification of the Kent Coast Lines . . . 467
Transatlantic Telephone Cable Orders . . . 467
Position of British Shipbuilding . . . 468
Liverpool Steam Ship Owners' Association . . . 468
Oxford Road Station, Manchester . . . 468
Marine Engineers' Annual Dinner . . . 468
Hydraulic or Pneumatic Actuators . . . 468
Welded Aluminium Tubes . . . 469
Ball Mills . . . 469

Continental Section

Advantages of Prestressed Concrete . . . 471
Precision Optical Measuring Equipment . . . 472
Siemens and Halske and Siemens-Schuckertwerke . . . 473
Expansion of French Oil Industry . . . 473

American Section Progress of the Tennessee Valley Authority. No. III . . . 474

LETTERS Science Museum Changes. Standards Making . . . 456
Why Restrict Output? . . . 457

BOOK REVIEWS . . . 457

NEWS AND NOTES British Standards Institution . . . 462
Industrial and Labour Notes . . . 470
Personal and Business . . . 478
British Patent Specifications . . . 479
Launches and Trial Trips . . . 480
Forthcoming Engagements . . . 480

INDEX TO ADVERTISERS: PAGE 137 **CLASSIFIED ADVERTISEMENTS: PAGE 129**

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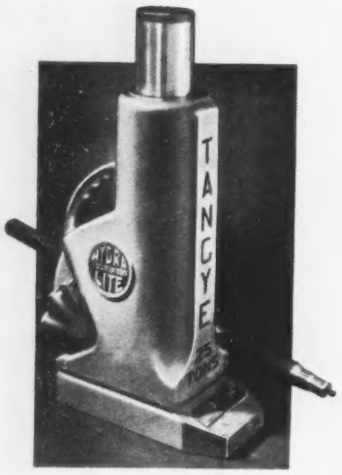

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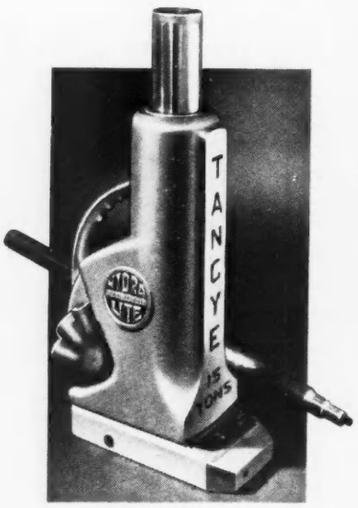

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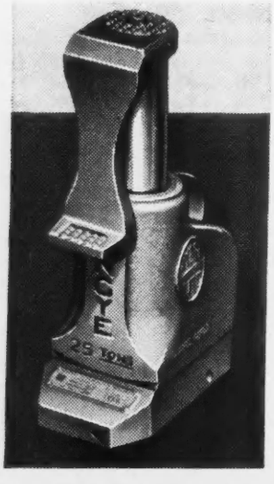

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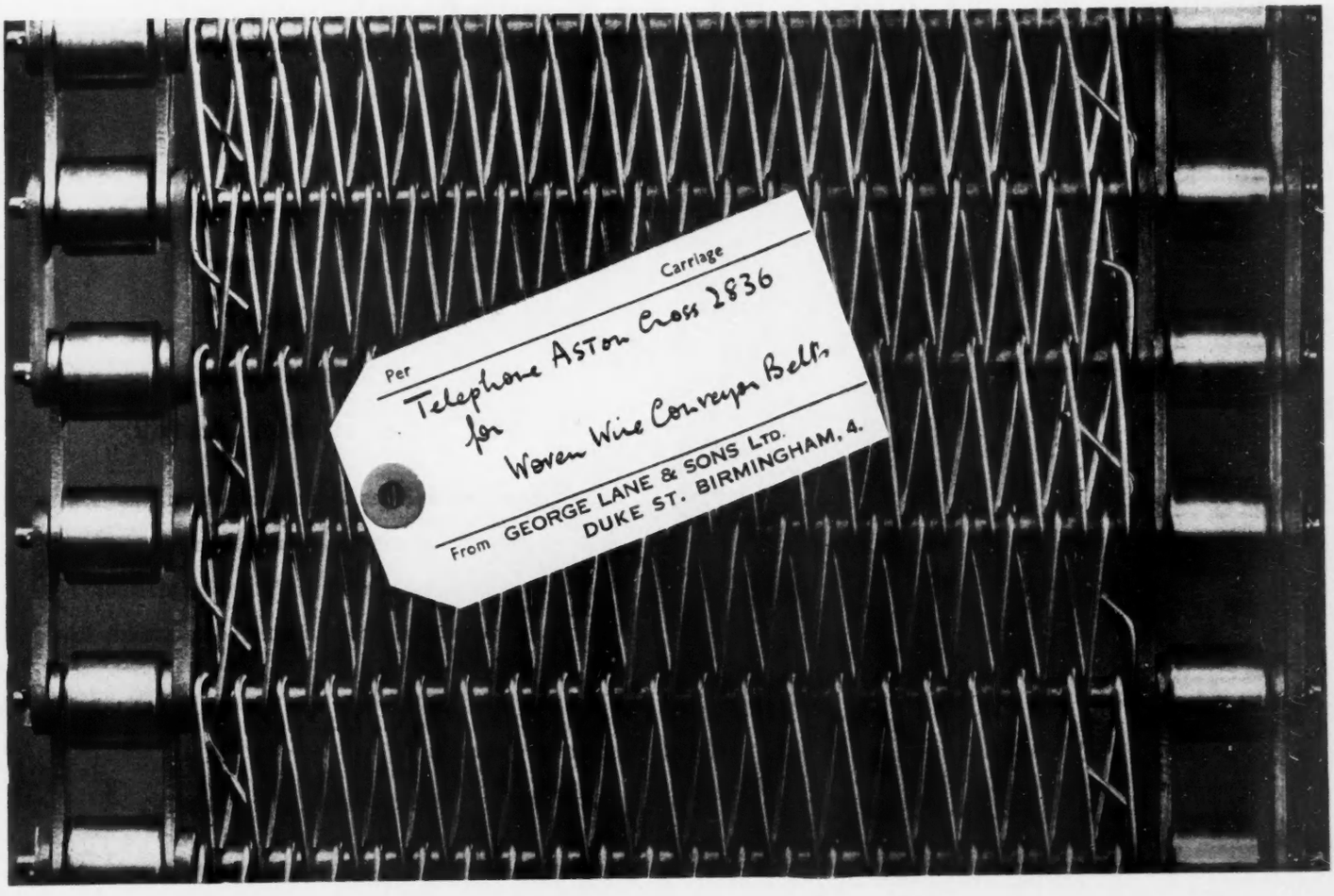

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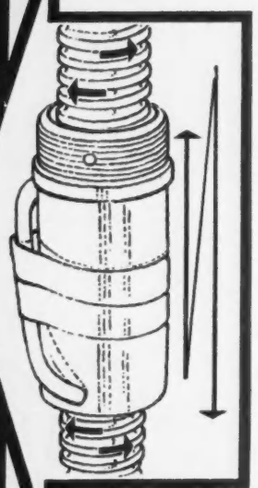

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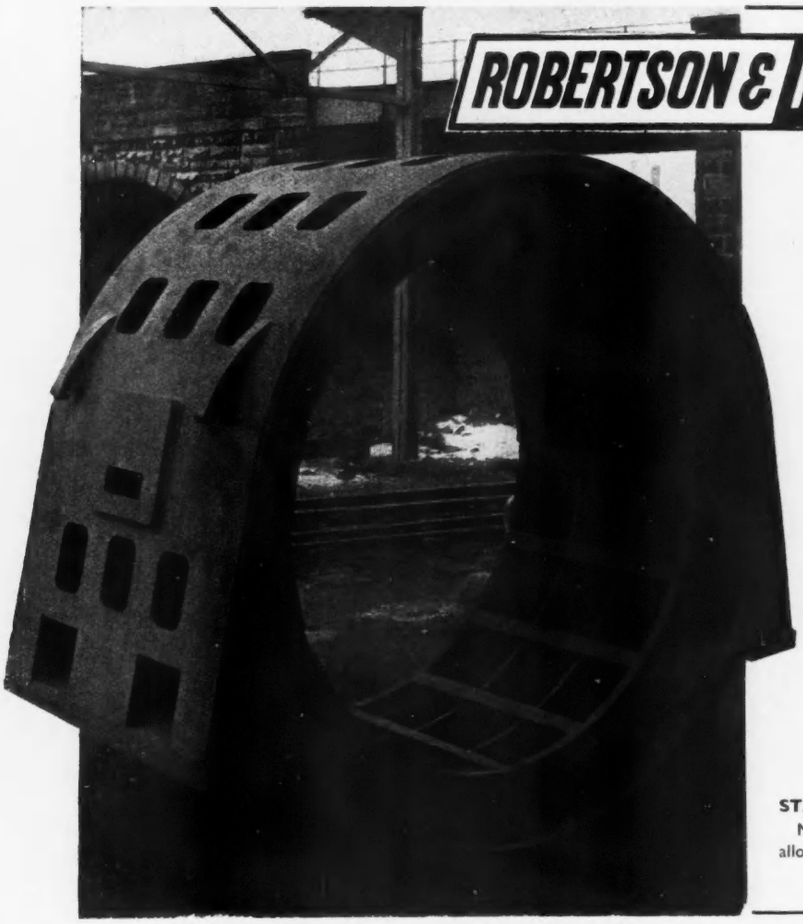

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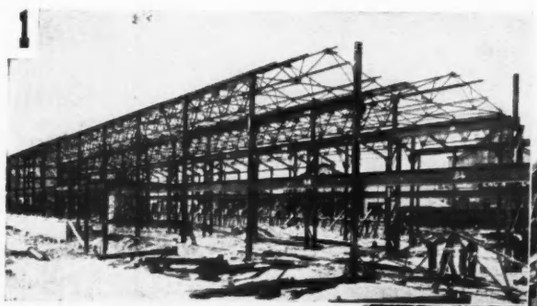

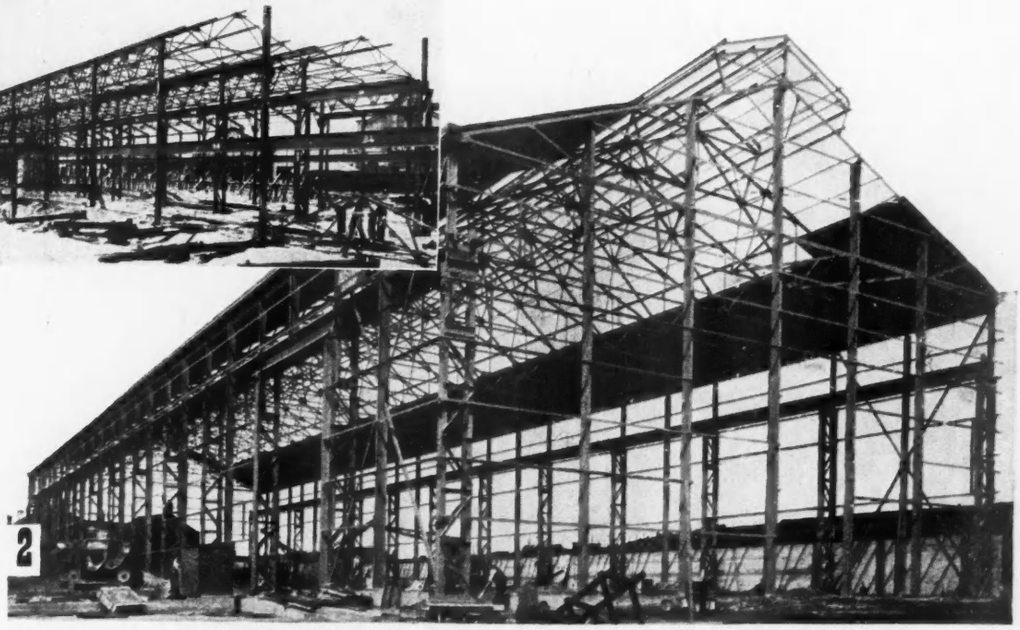

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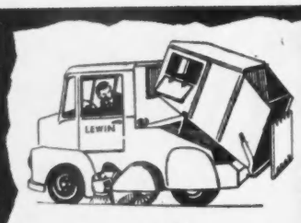

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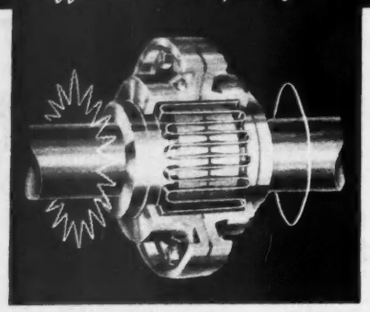

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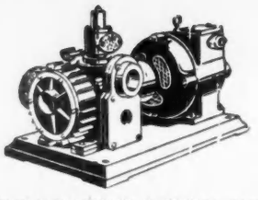

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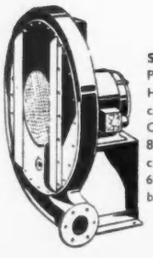

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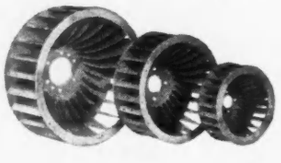

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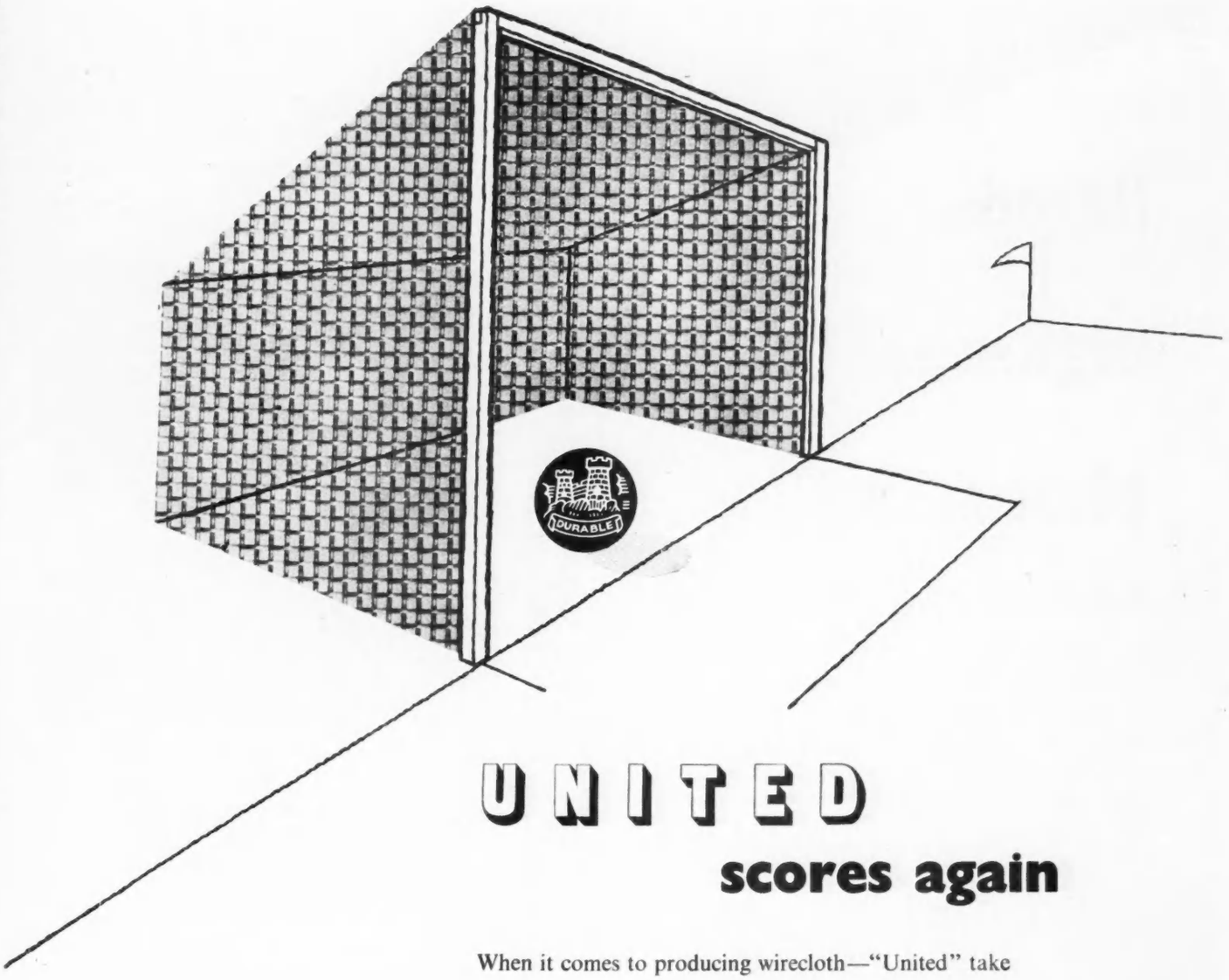

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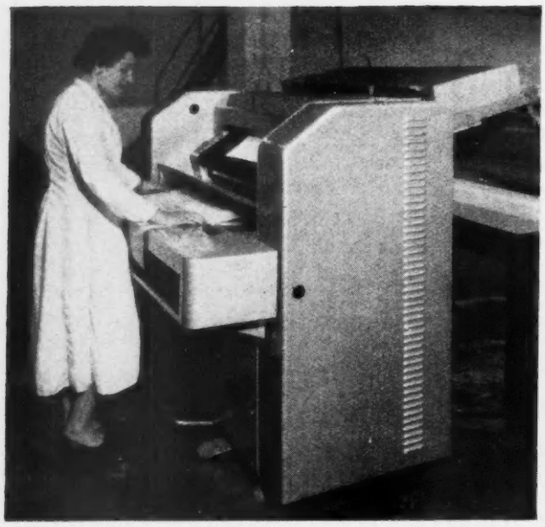

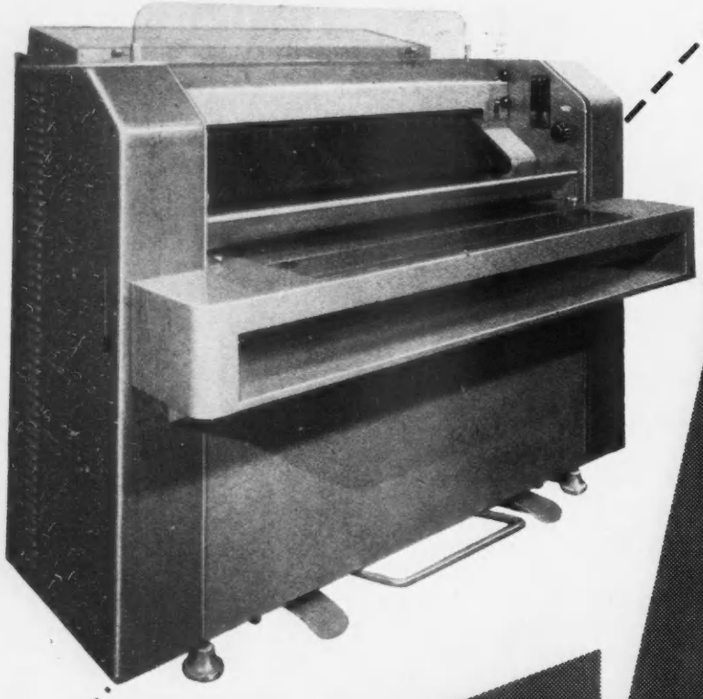

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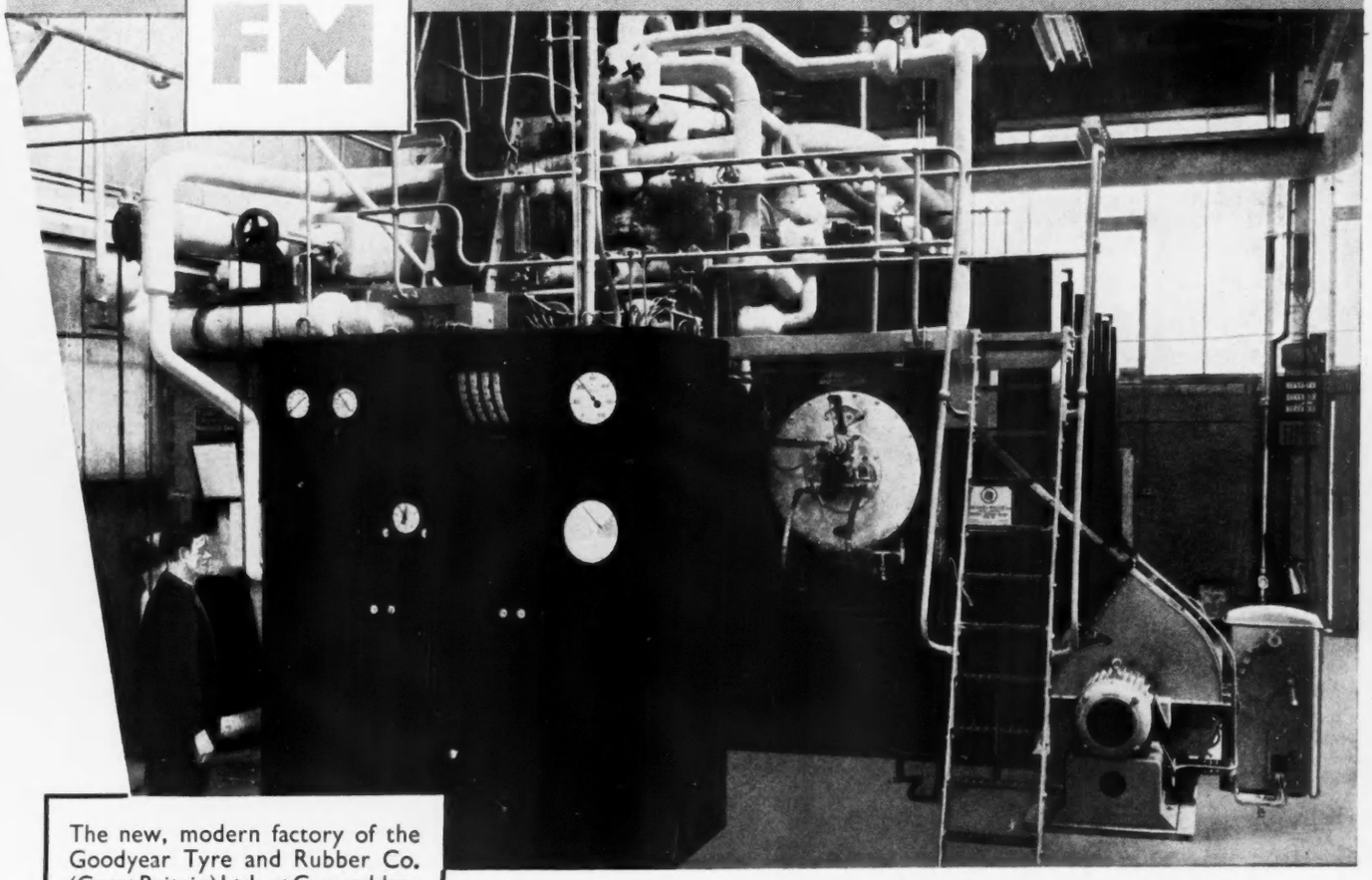

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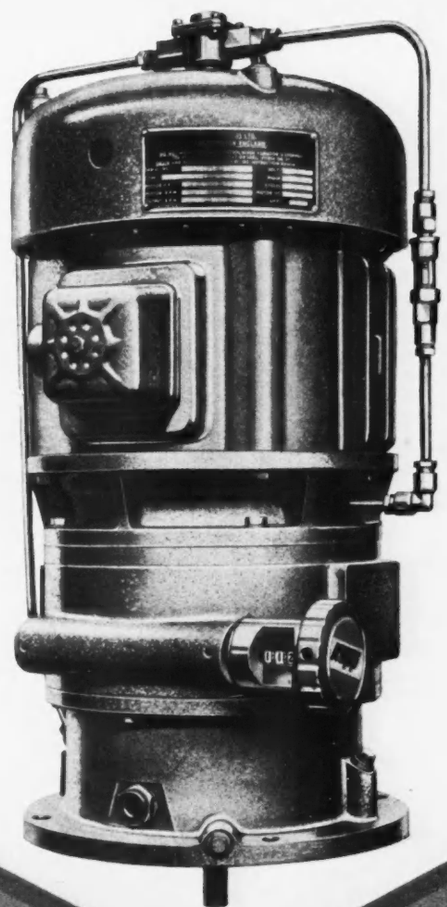

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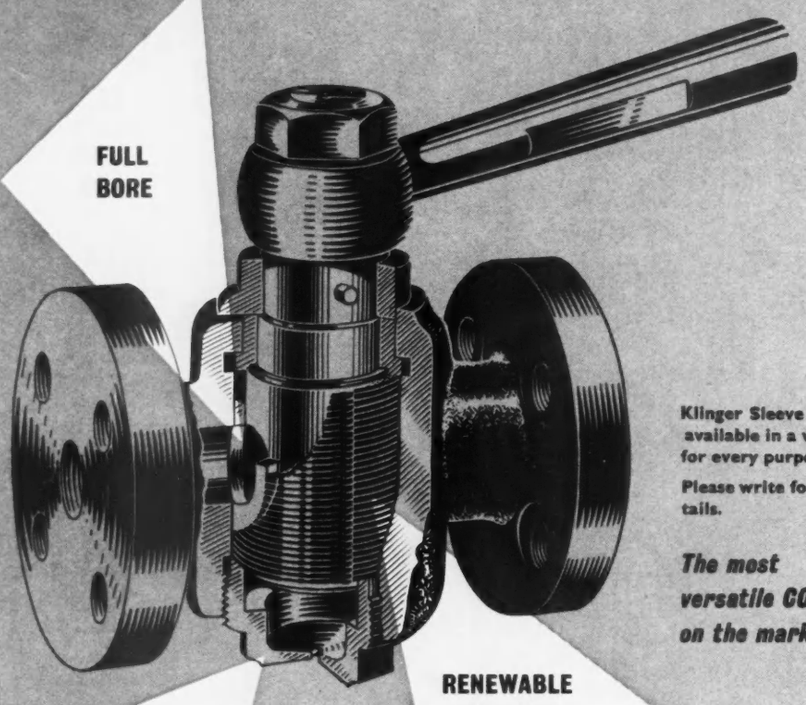

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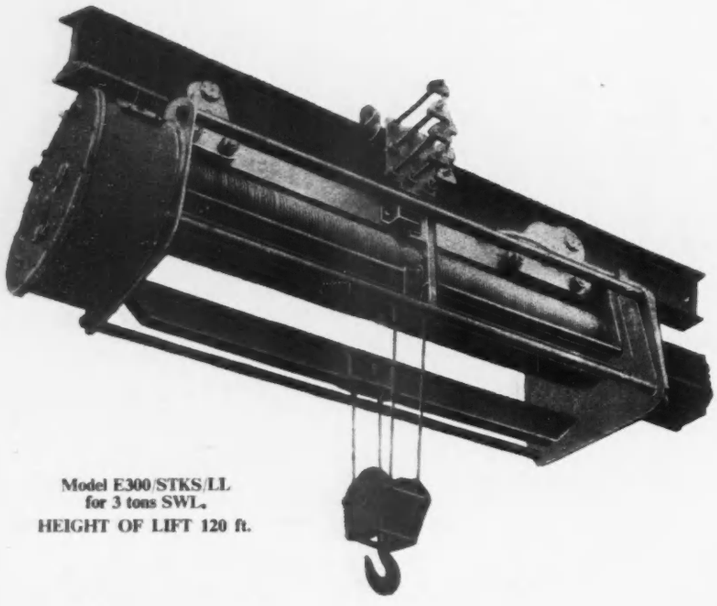

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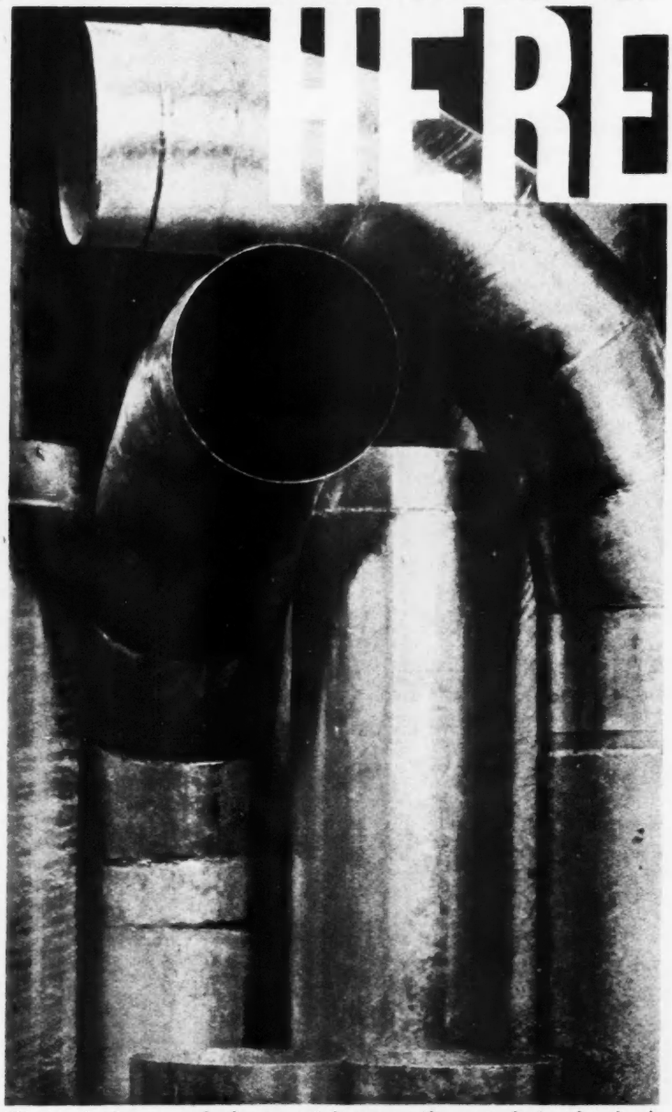

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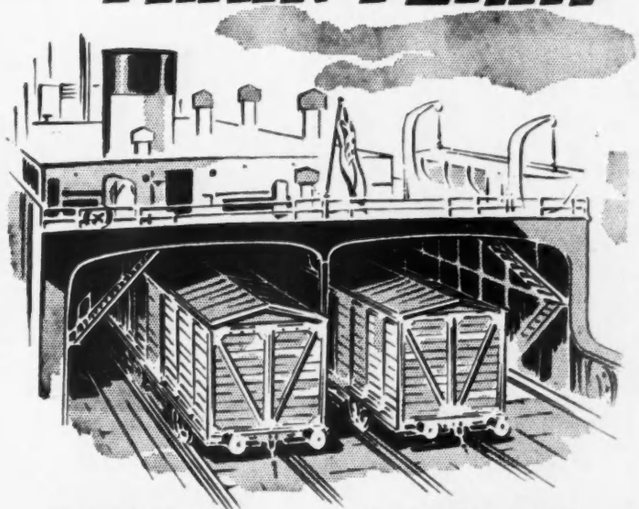

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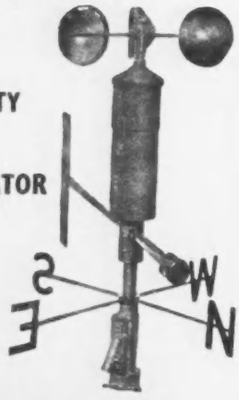

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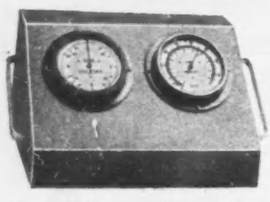

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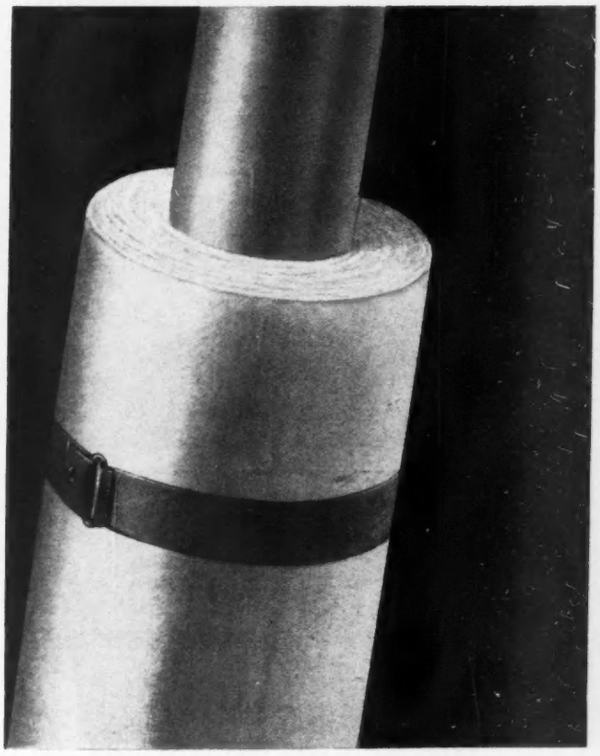

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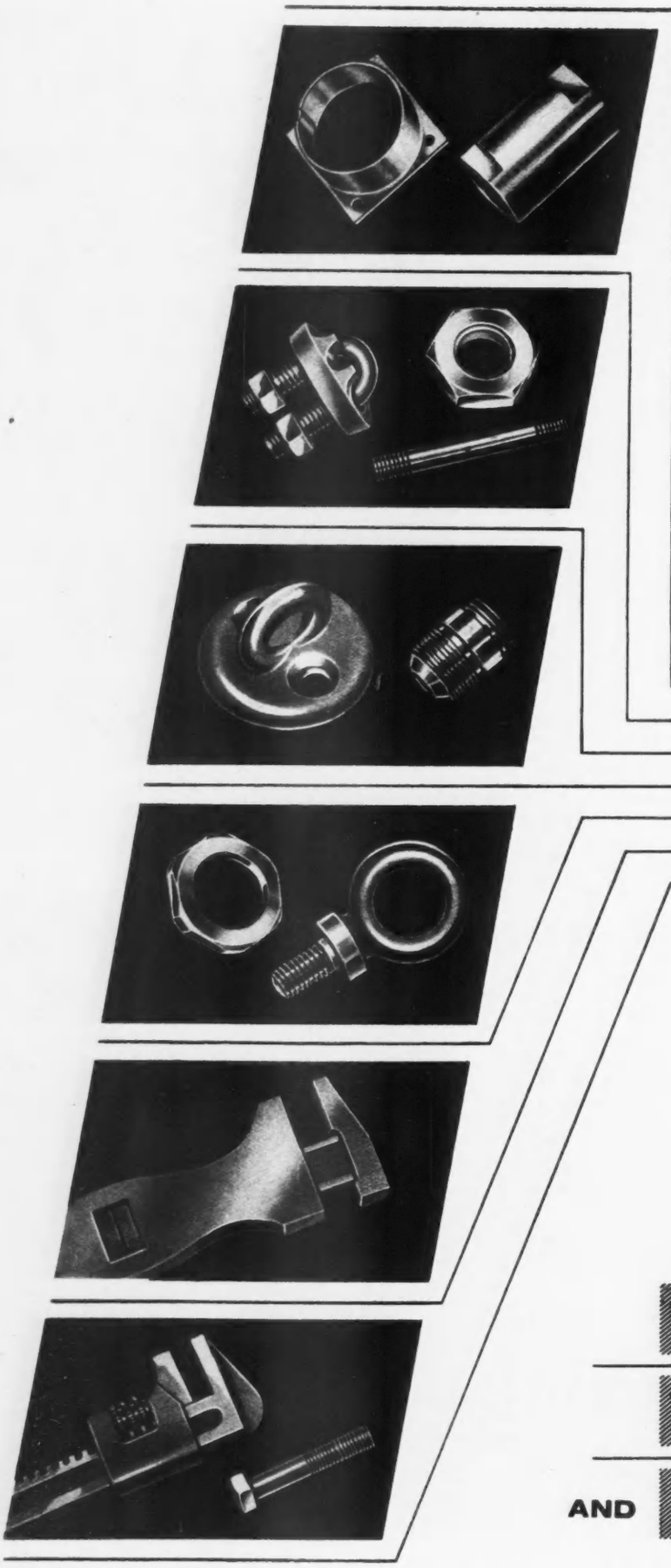

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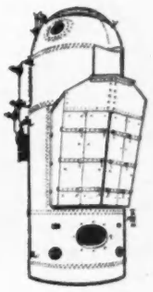

. . . are cause for anxiety and losses in many production processes. They are avoidable and where they exist consideration should be given to the means of overcoming them.

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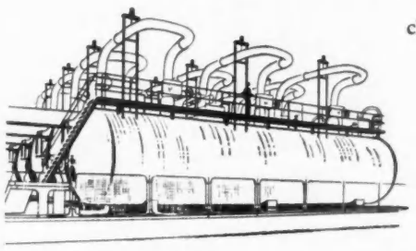

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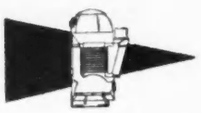

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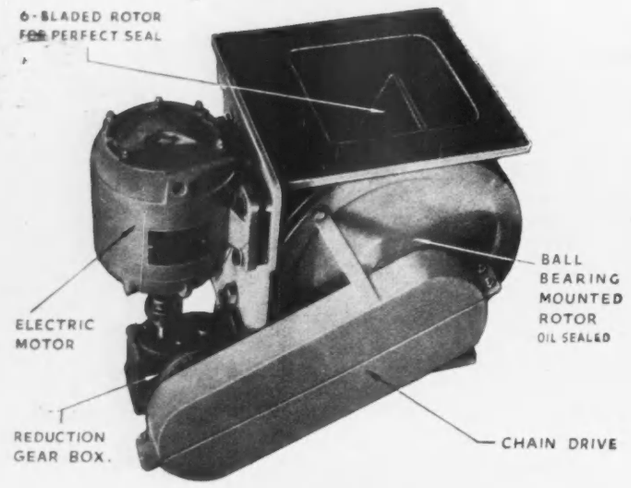

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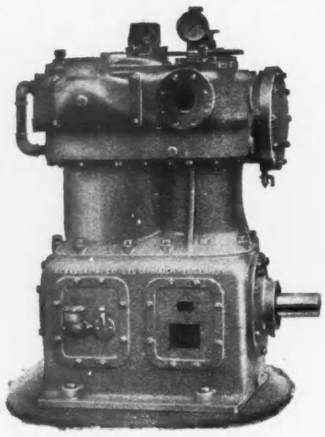

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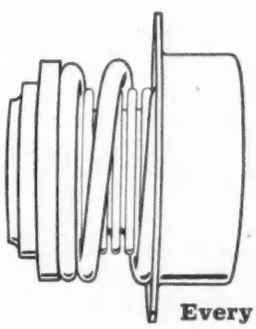

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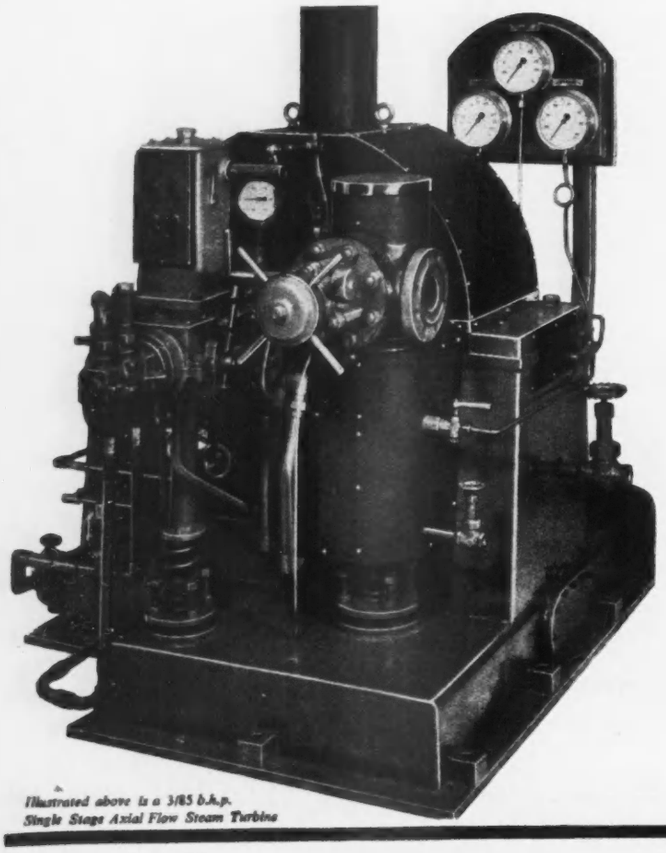

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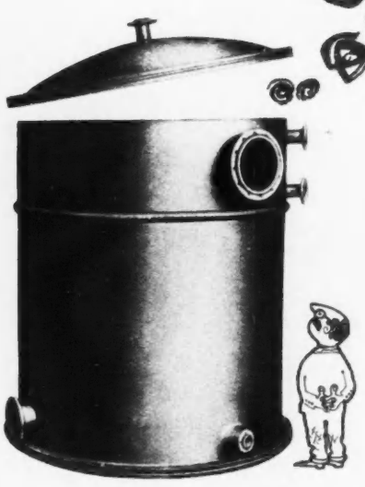

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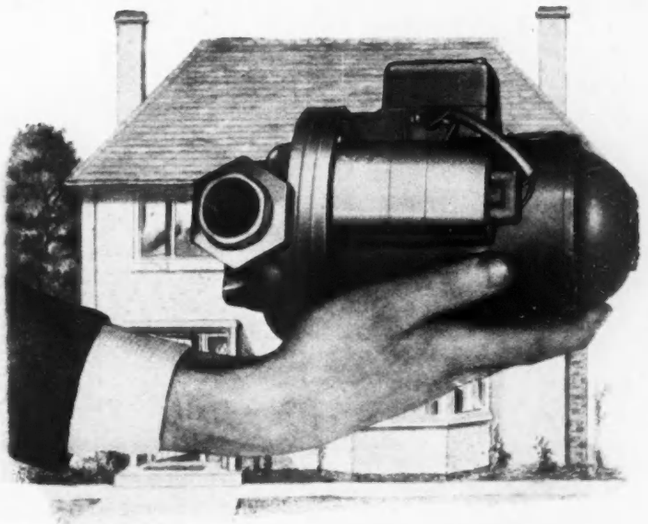

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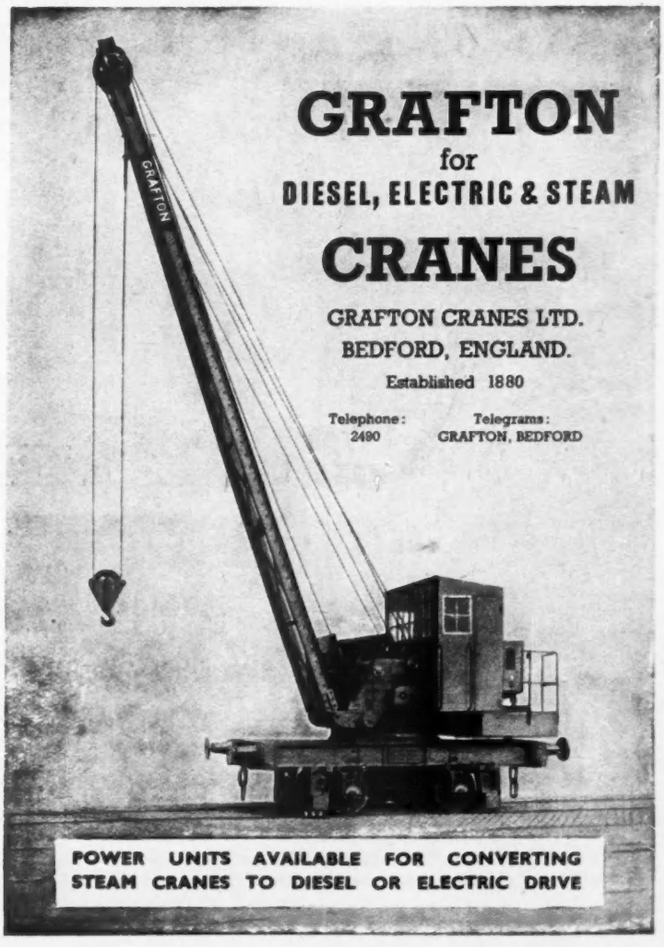

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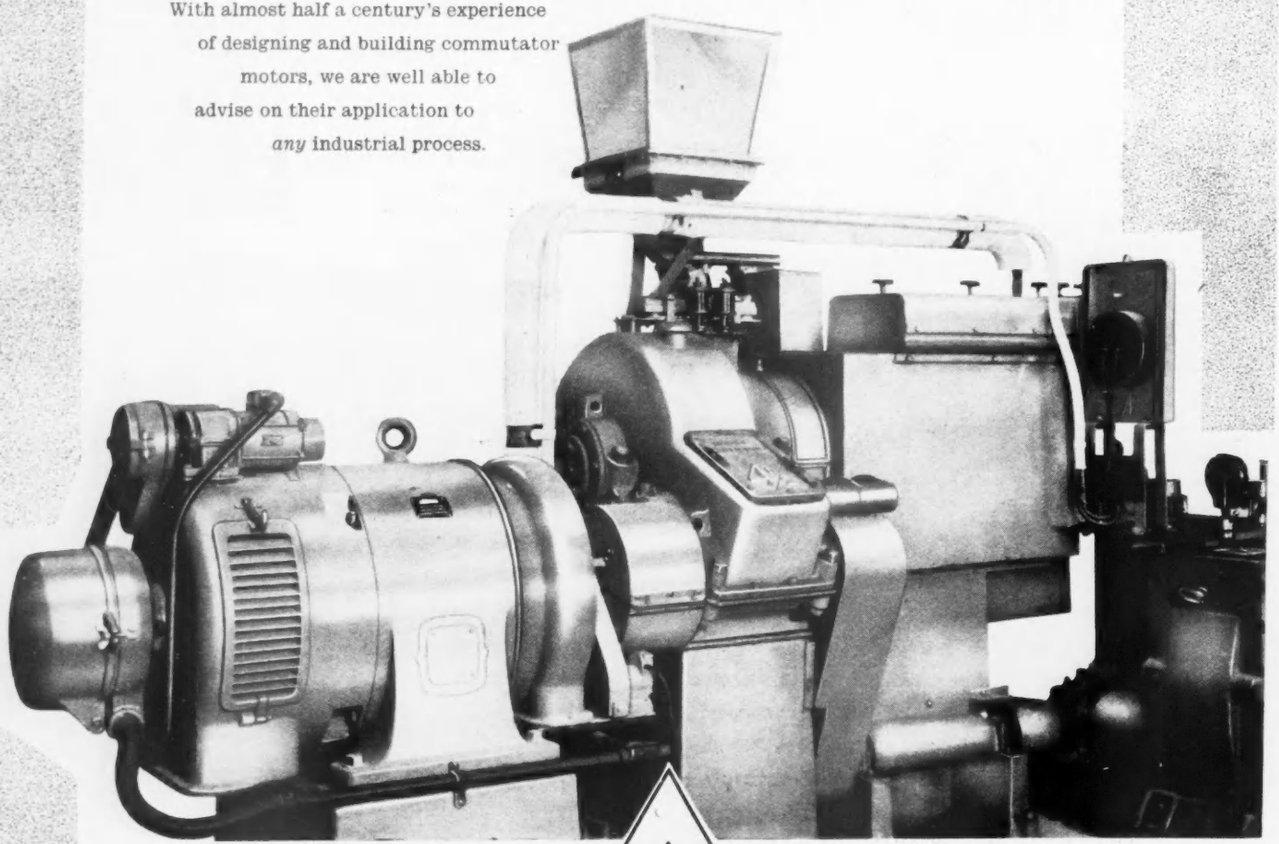

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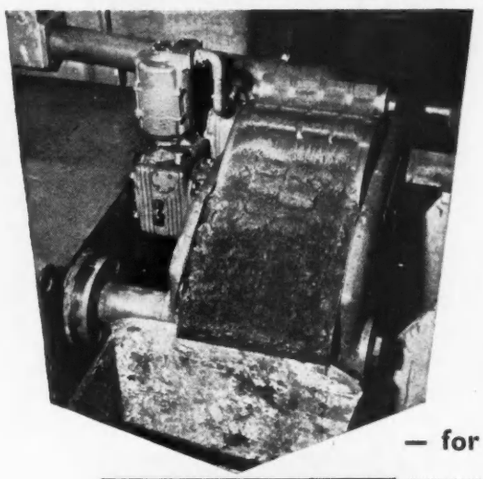

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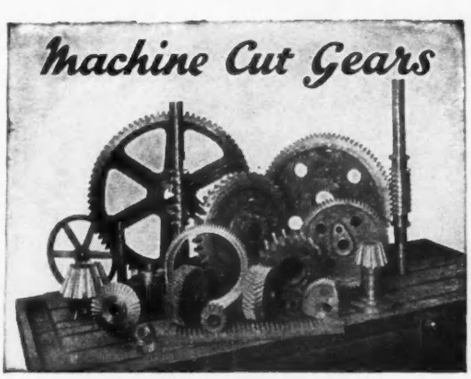

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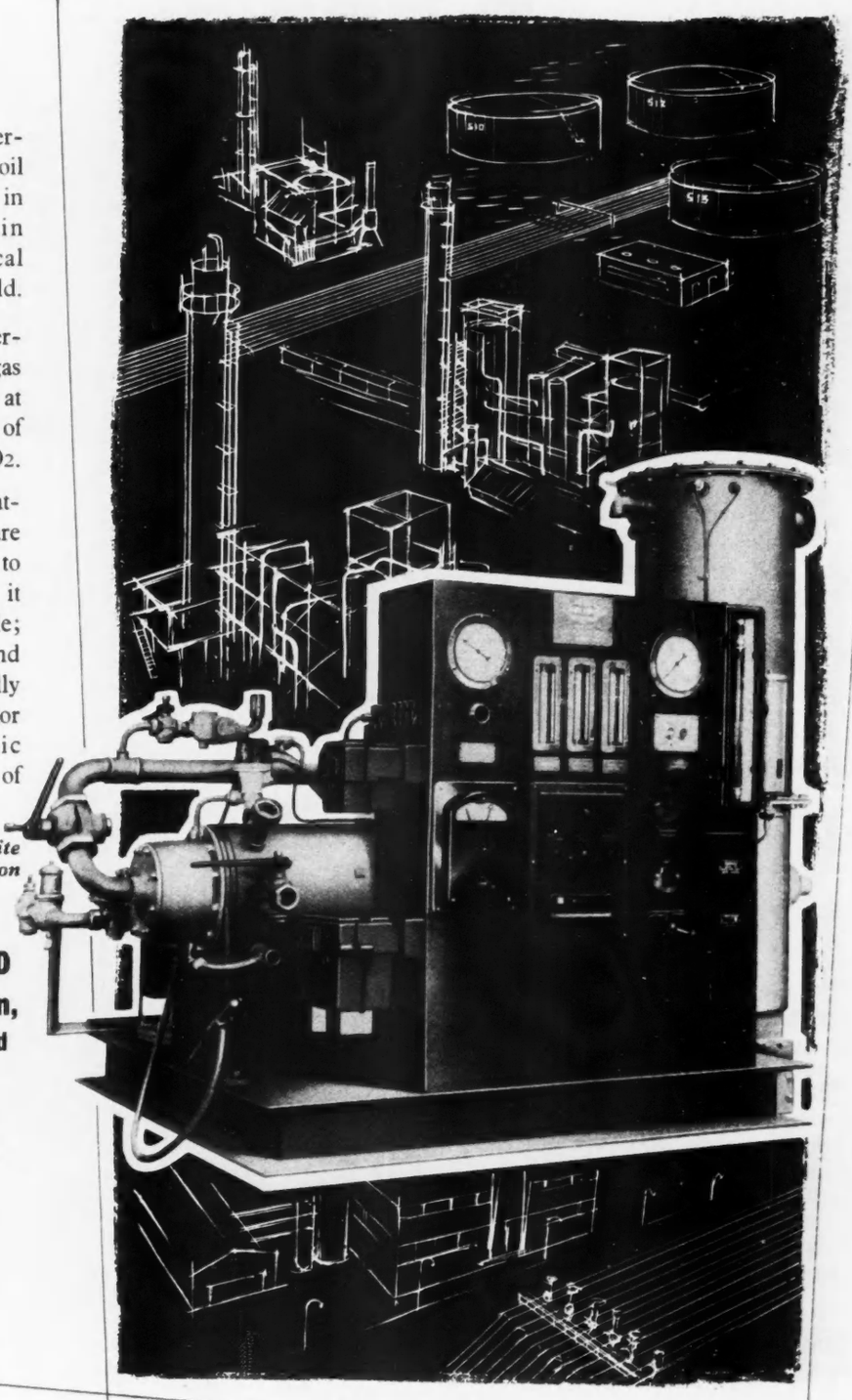

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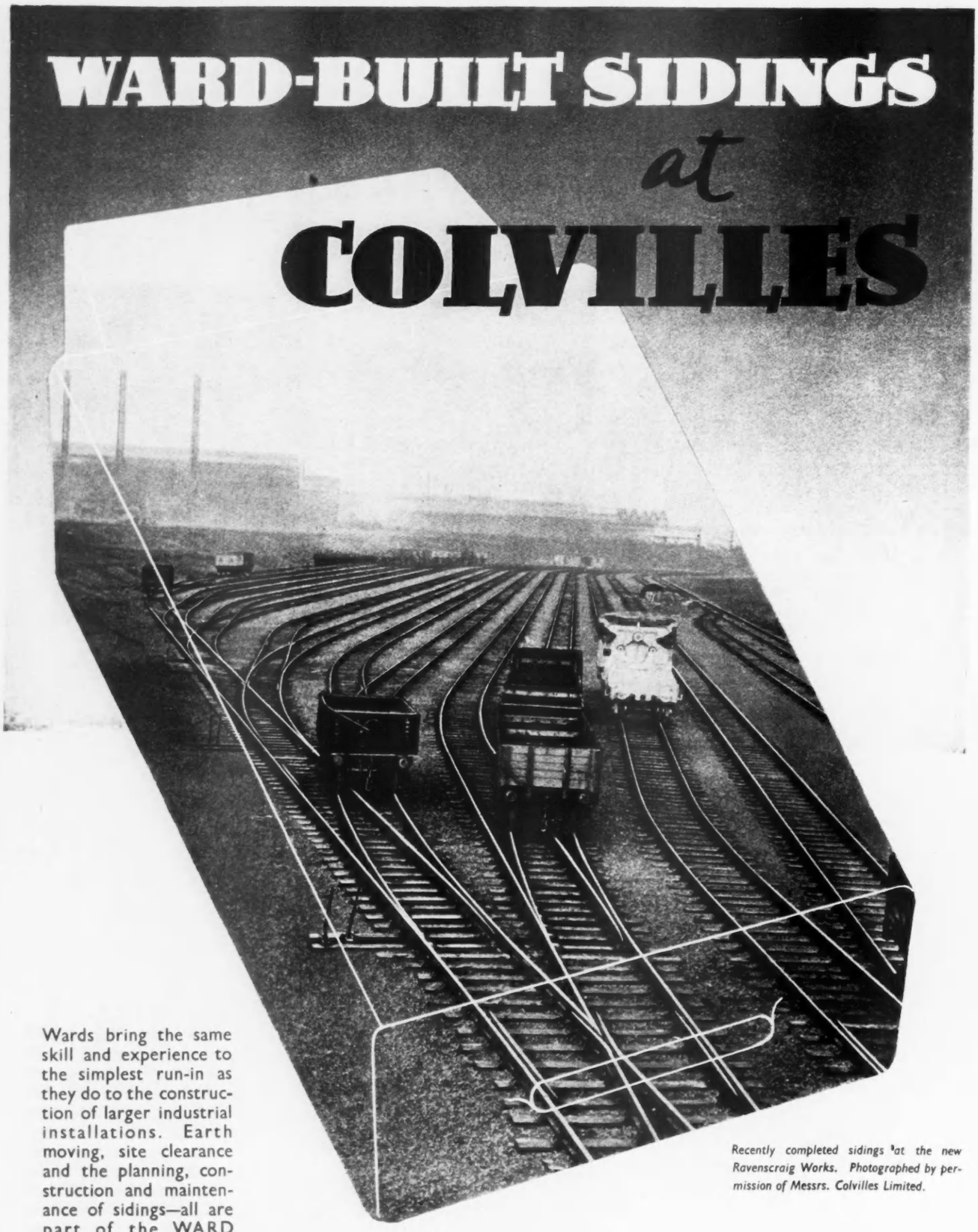

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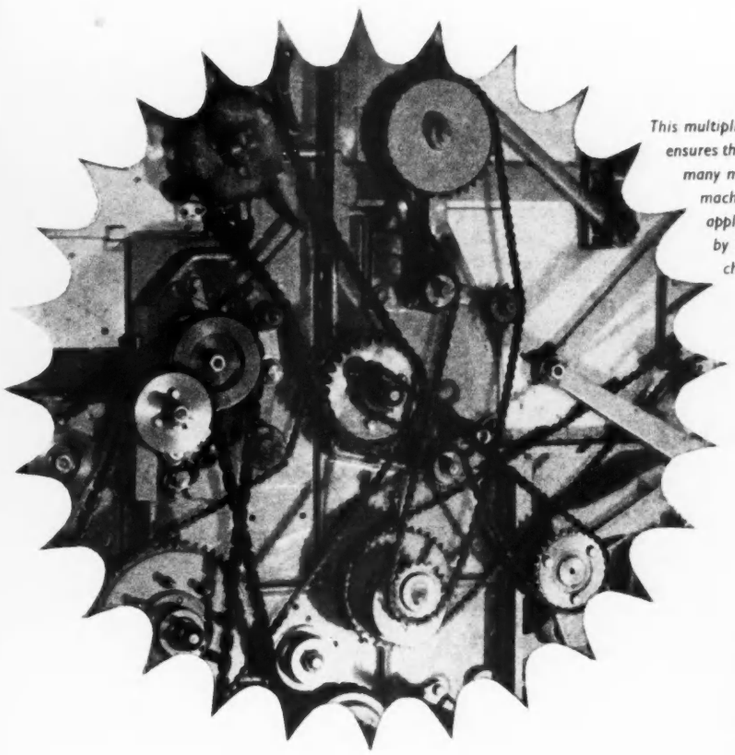

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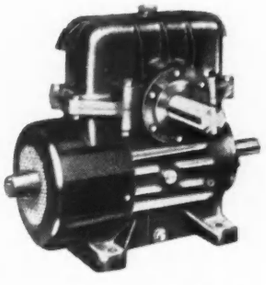

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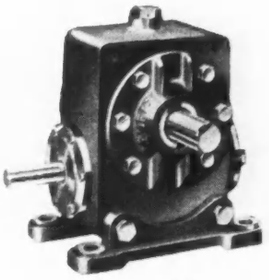

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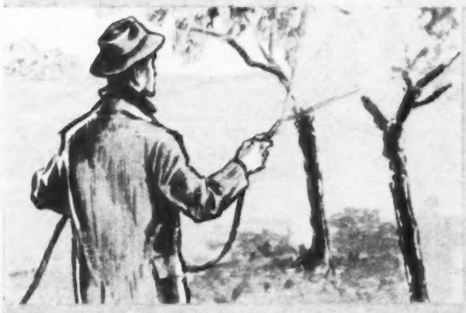

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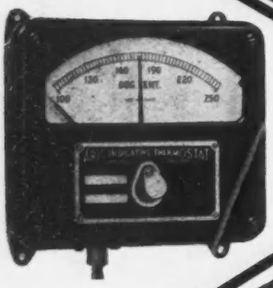

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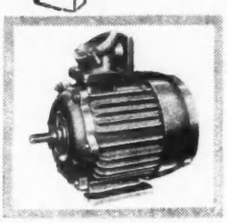

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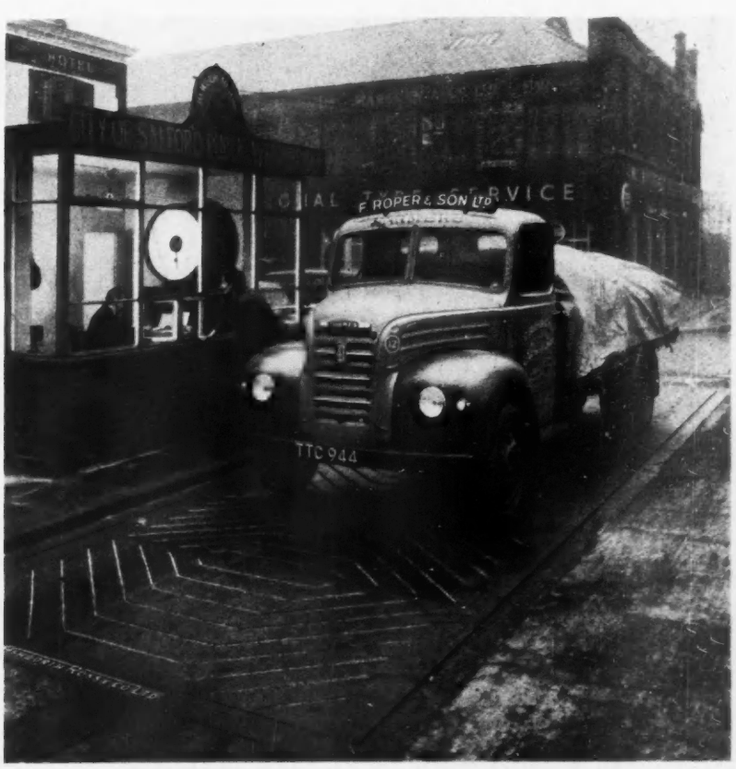

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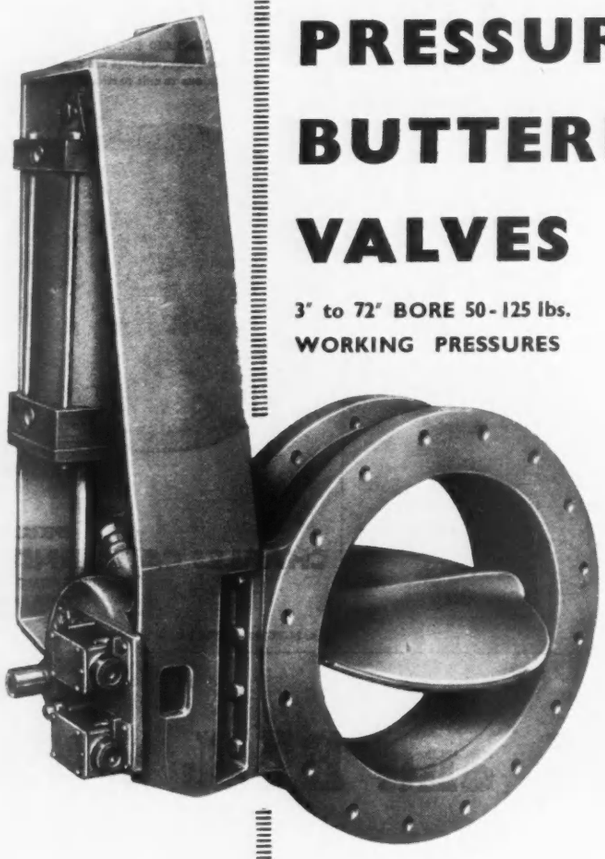

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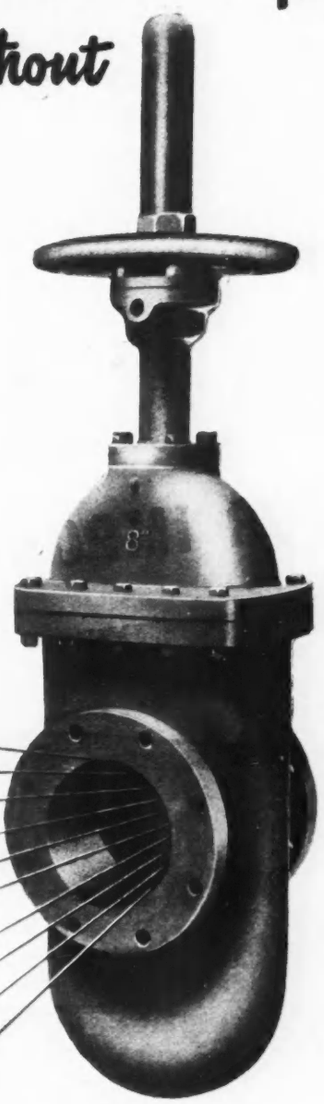

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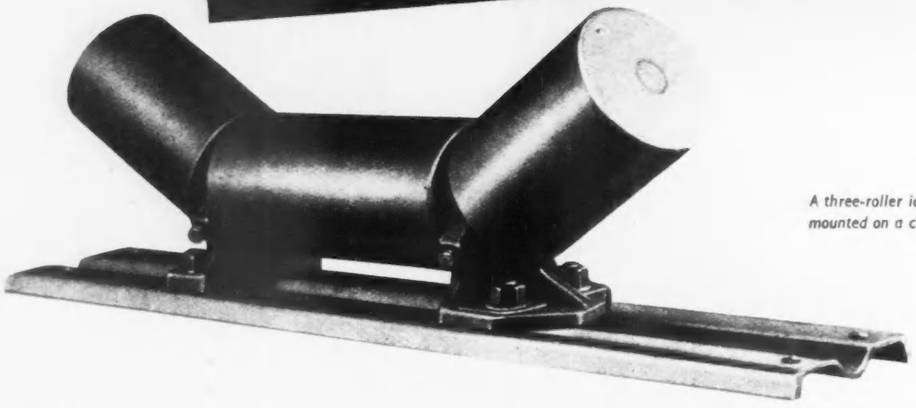

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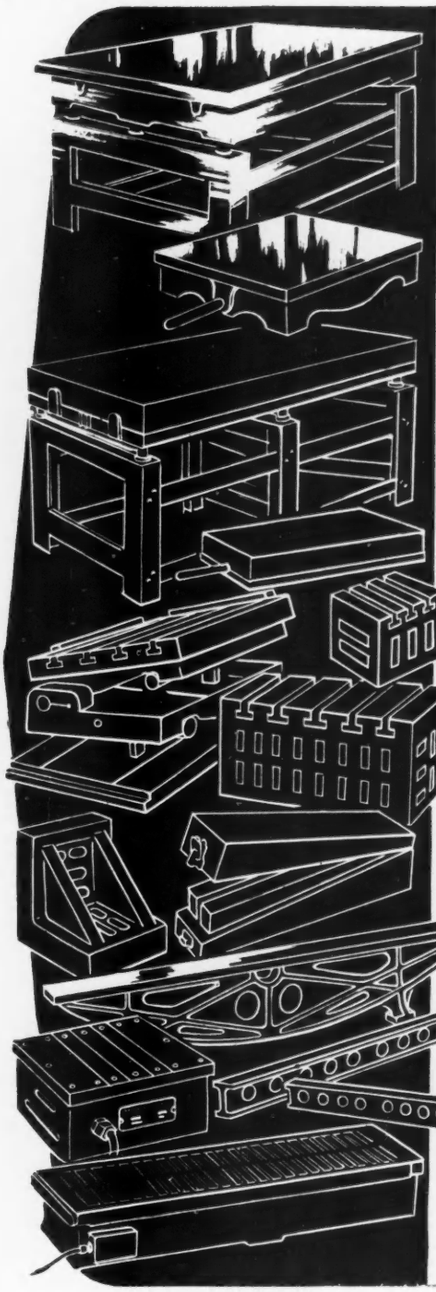

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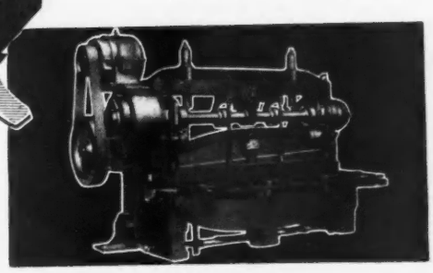

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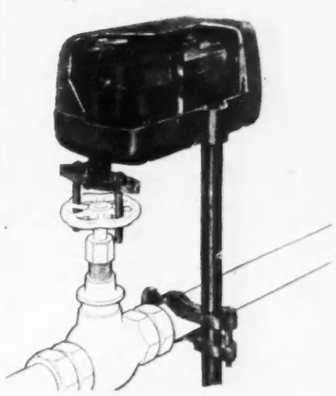

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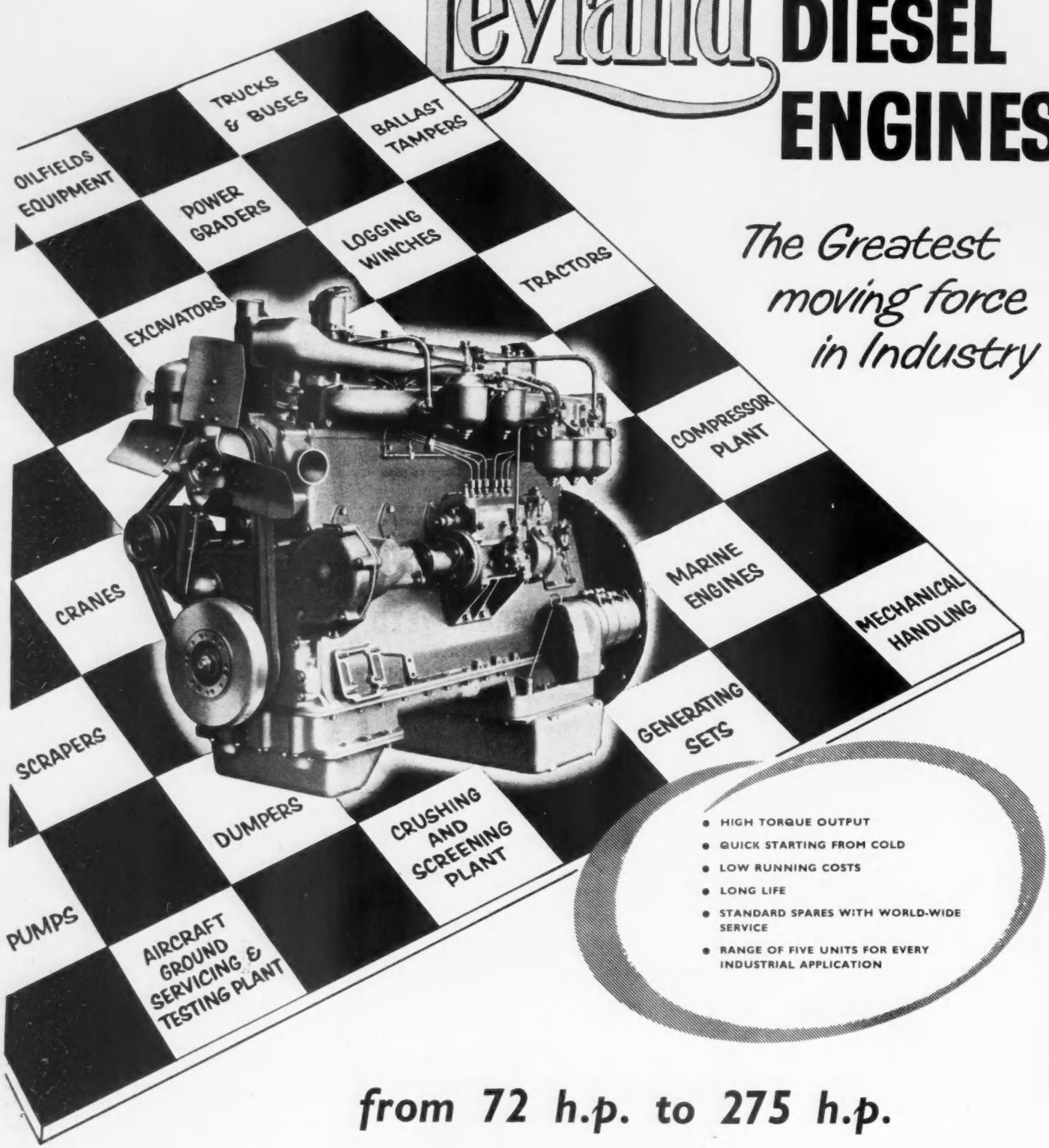

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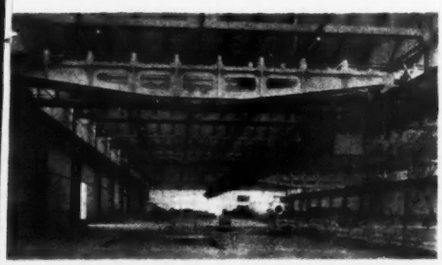

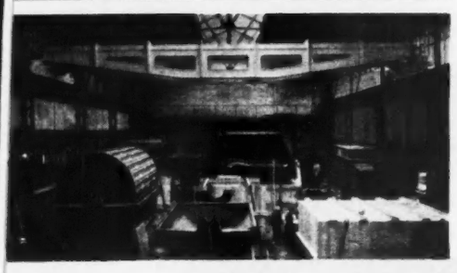

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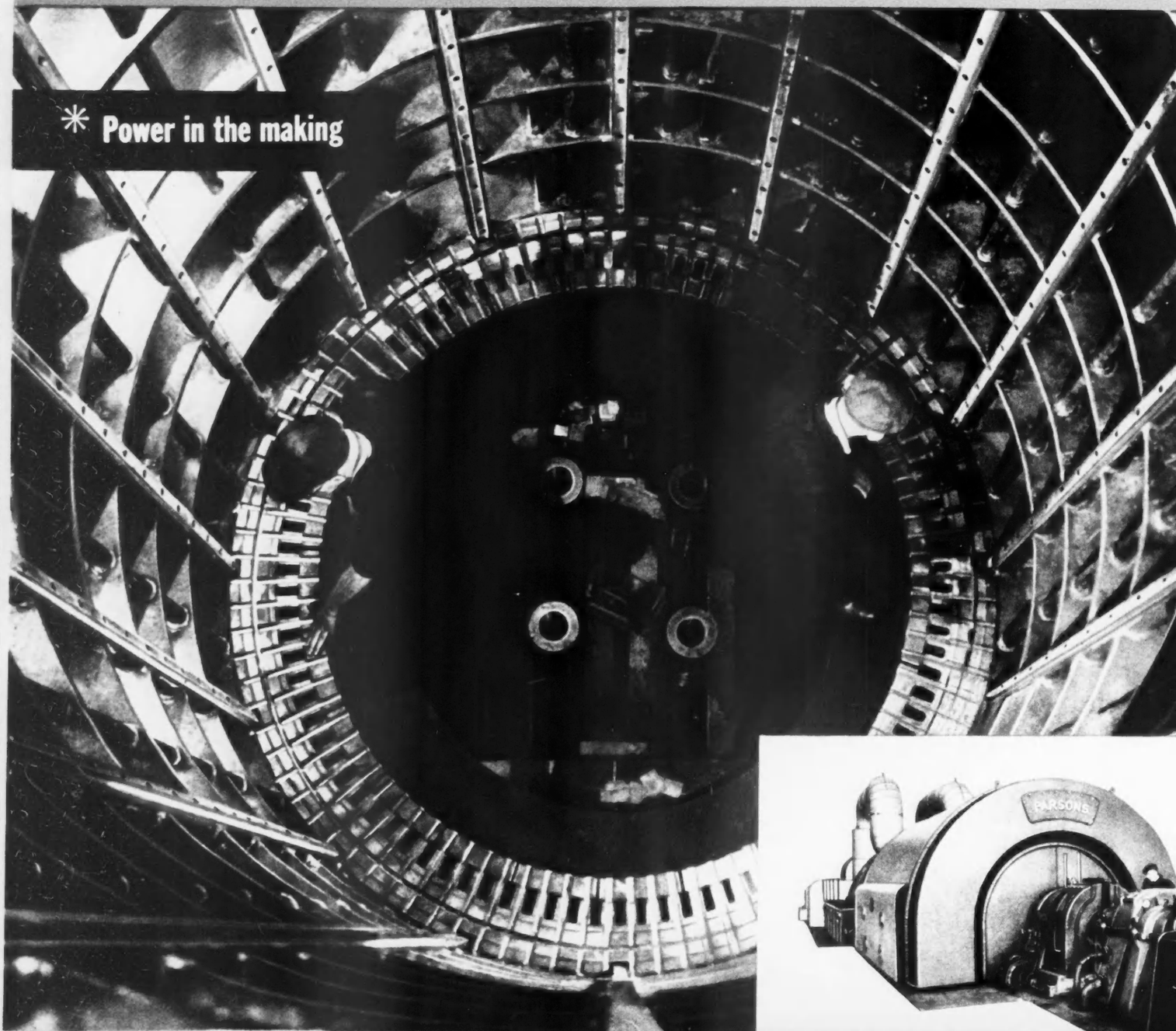

Fitting core end plate to the generator stator.

Inset: A typical completed 120 MW set.

At PARSONS Heaton Works some of the largest electrical machines in the world are produced. At the present time turbo-generators of up to 550,000 kW are on order or under construction and many of the type illustrated here are being installed in C.E.G.B. power stations throughout the country.

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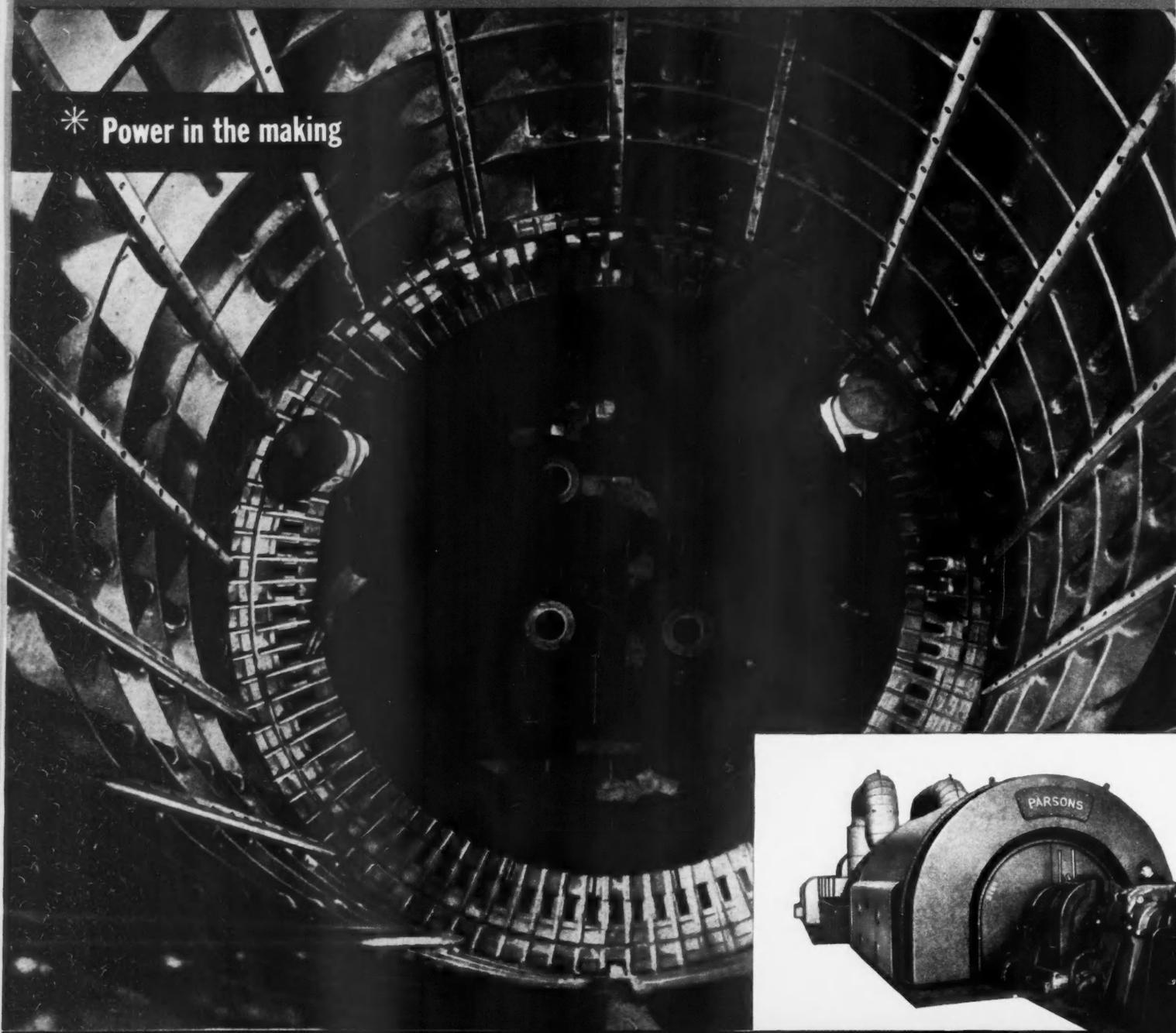

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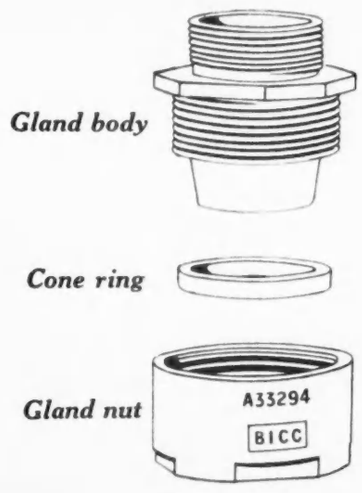

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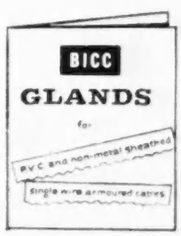

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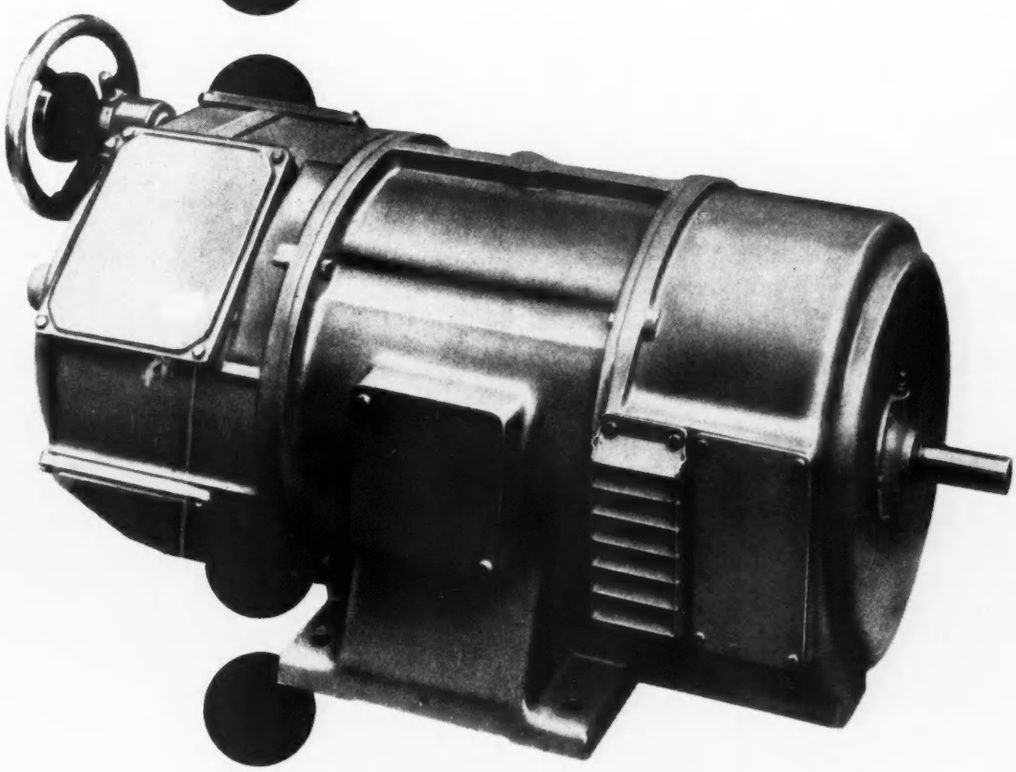

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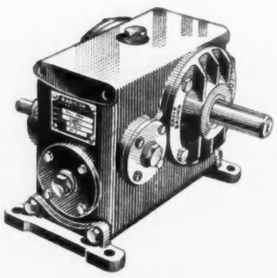

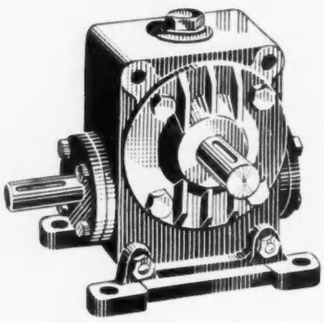

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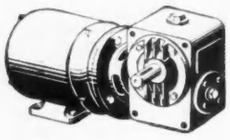

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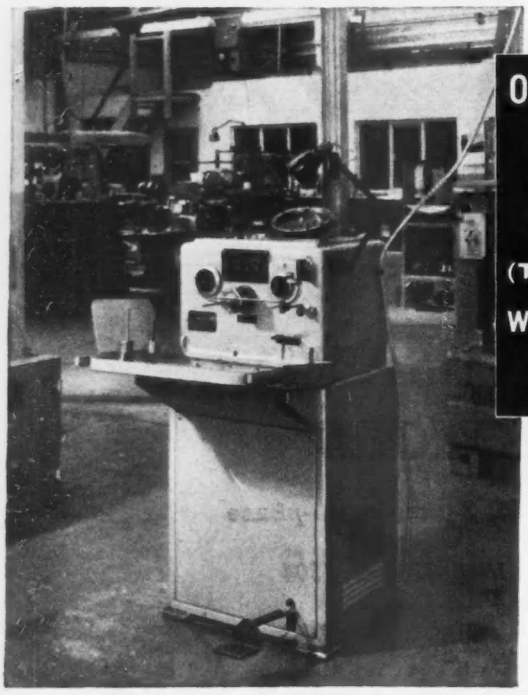

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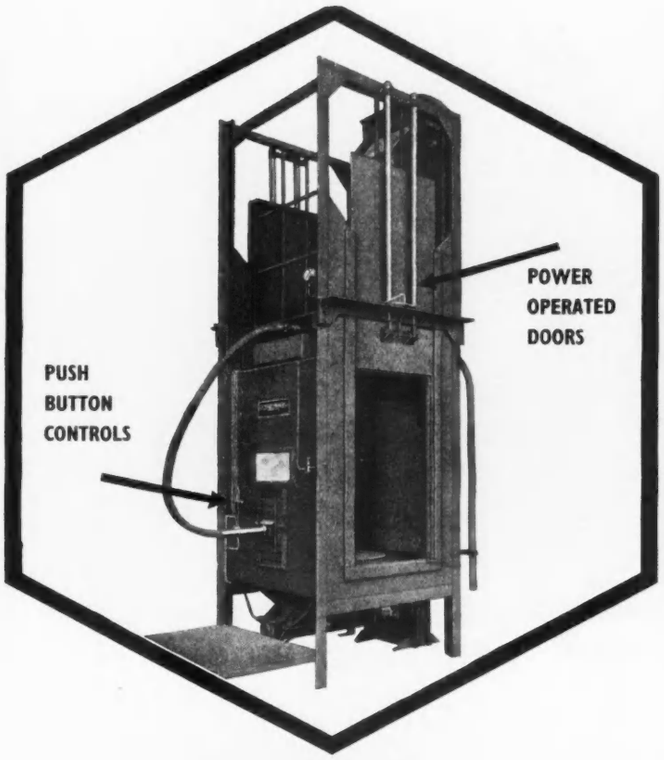

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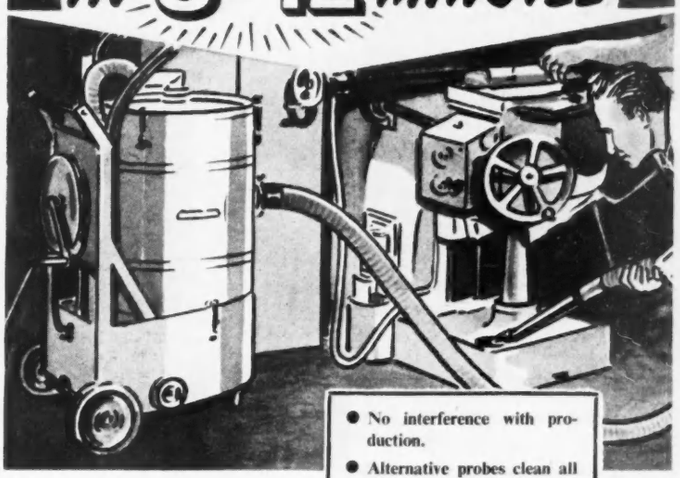

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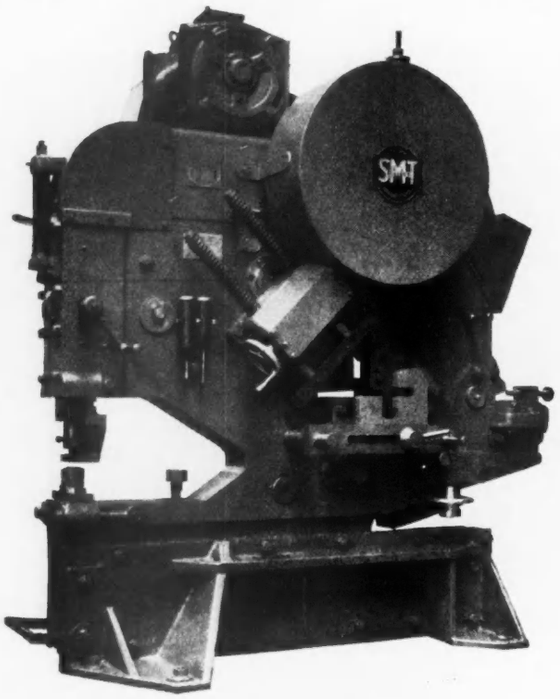

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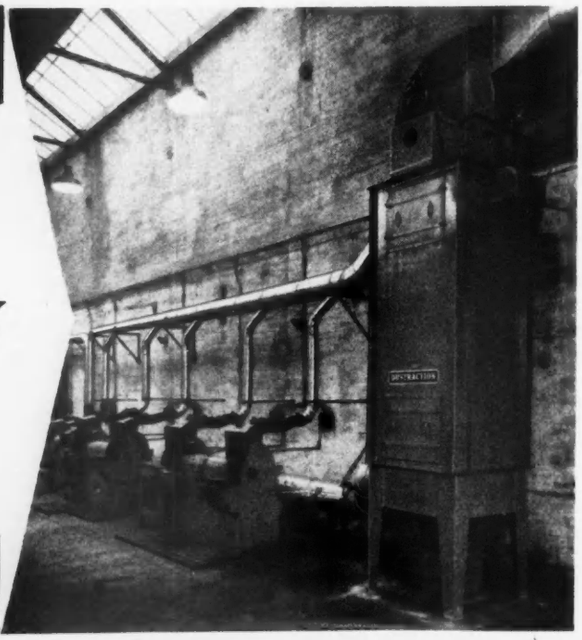

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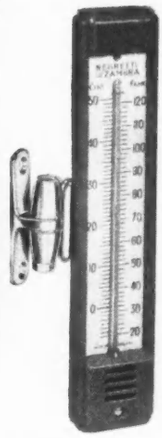

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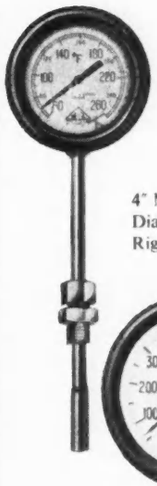

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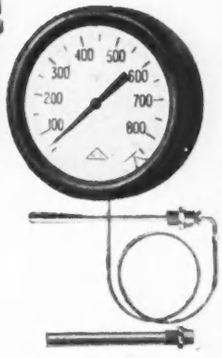
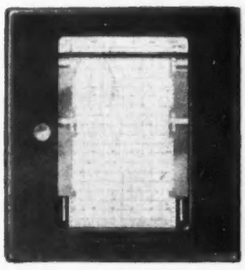
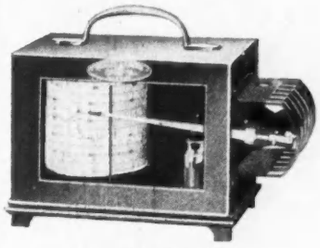


Distance-type Mercury-in-
steel Dial Thermometer



Resistance Thermometer
Recorder



Bi-metallic Recording
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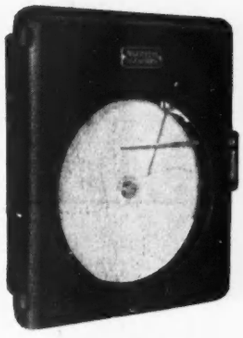

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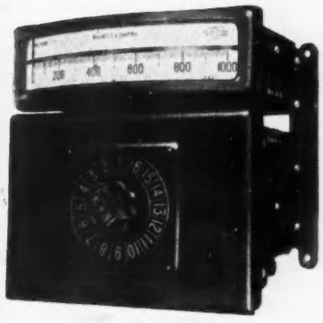

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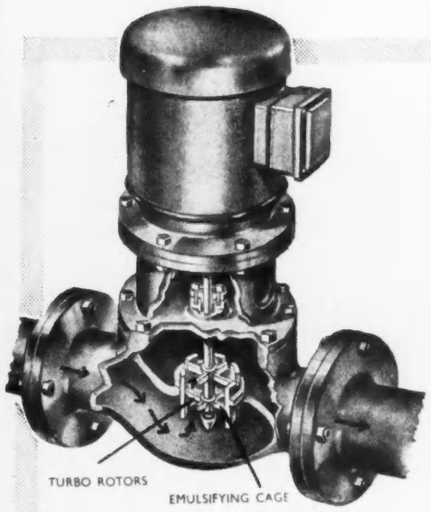

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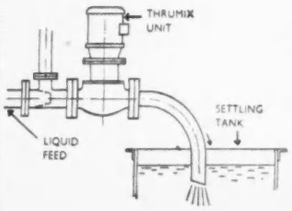

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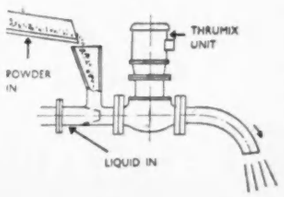

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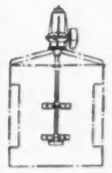

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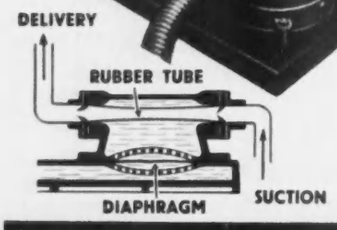

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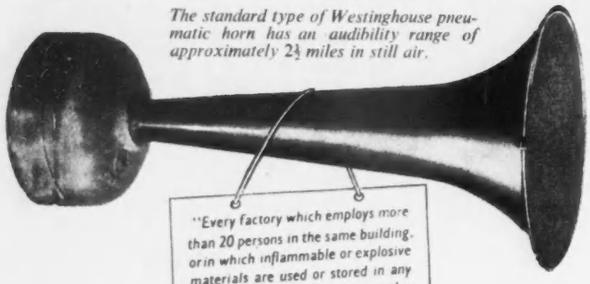

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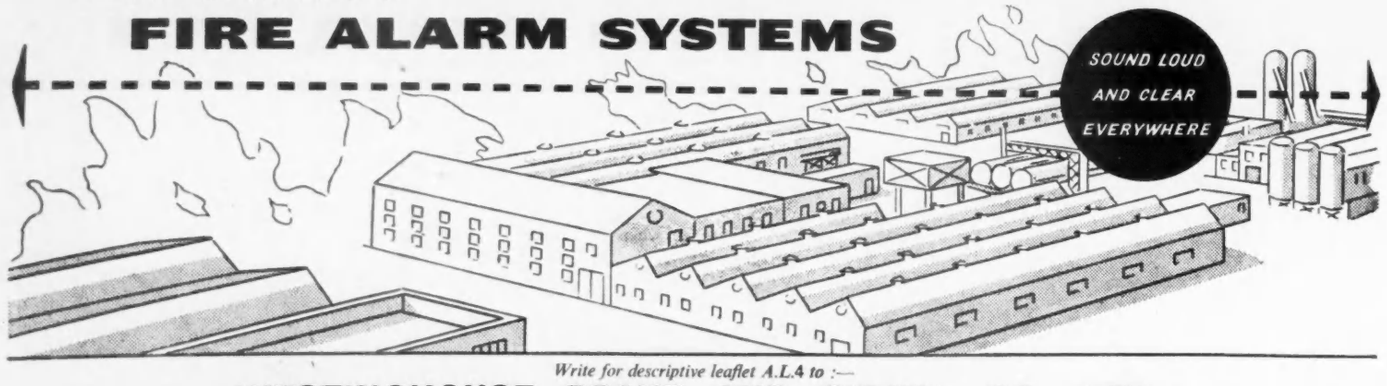

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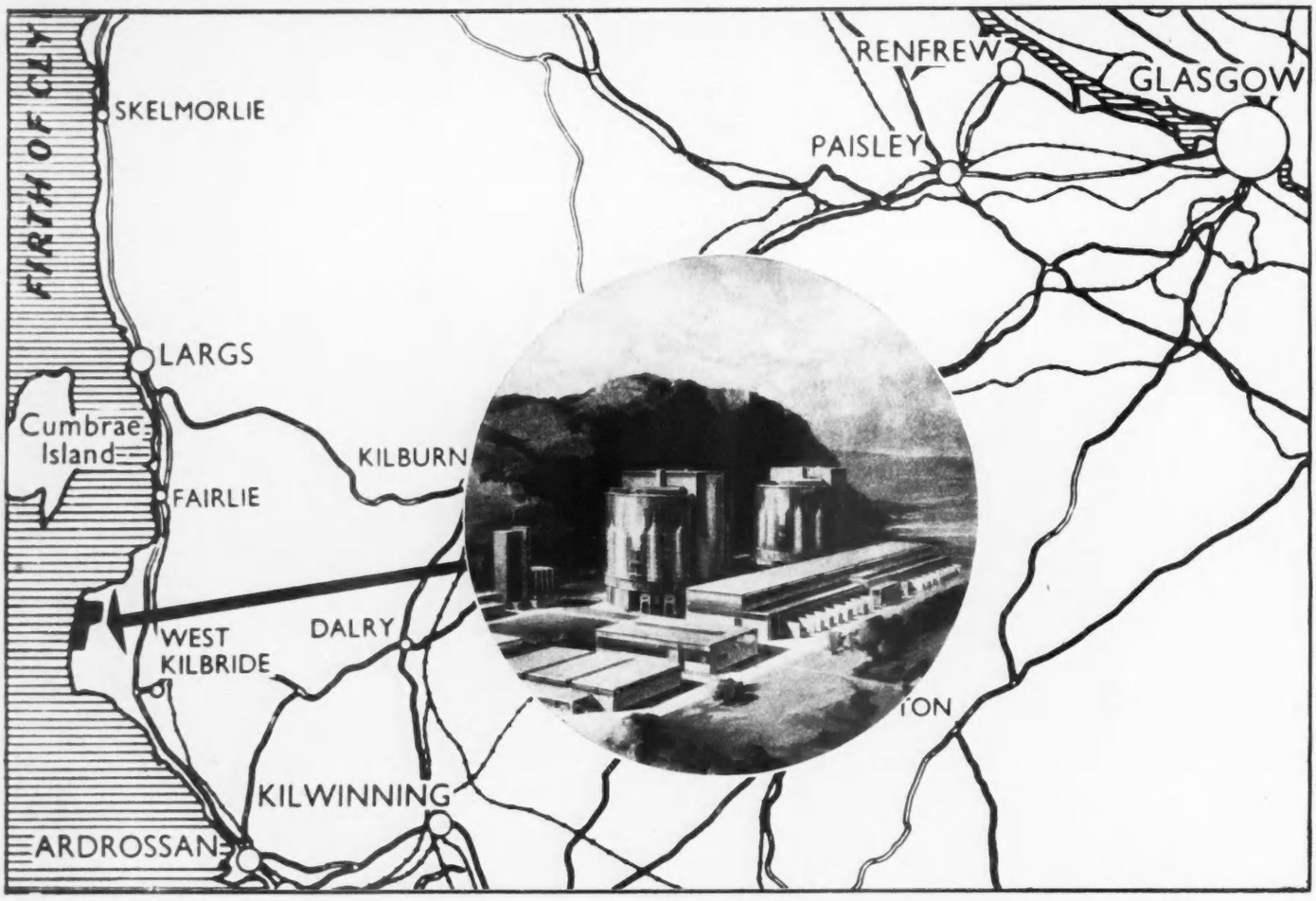

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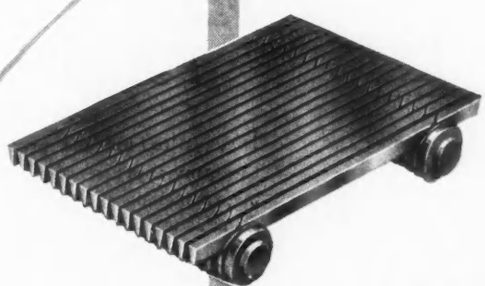

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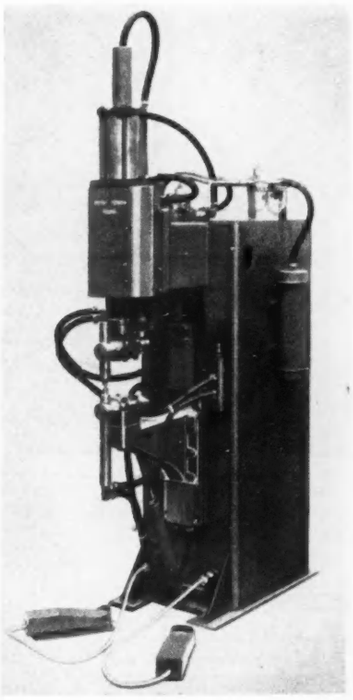

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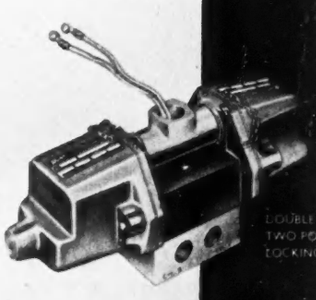

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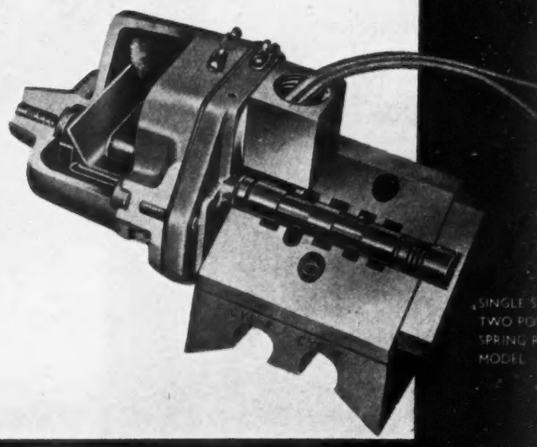

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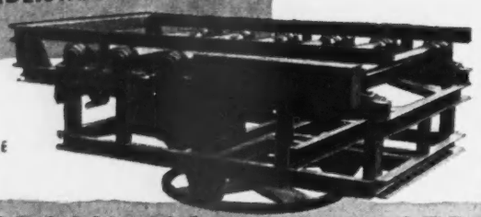

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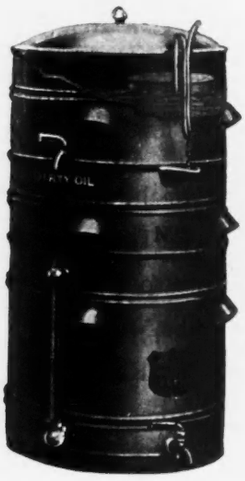

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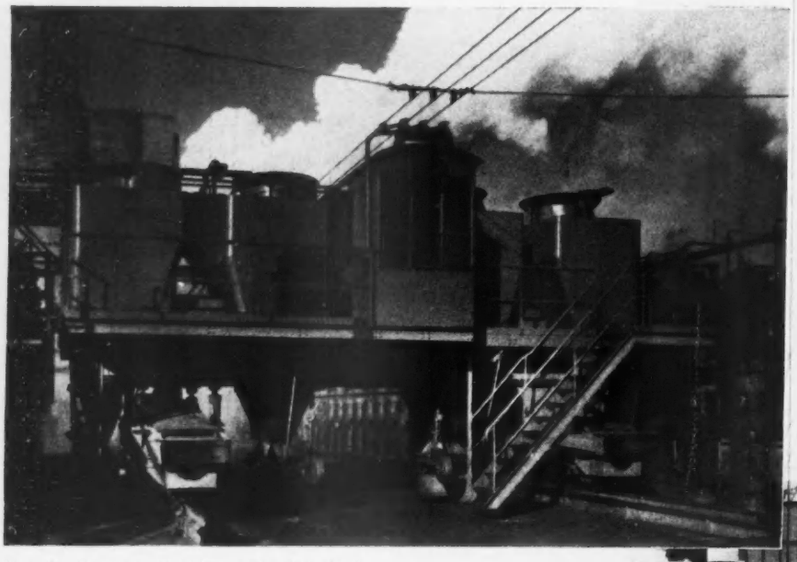

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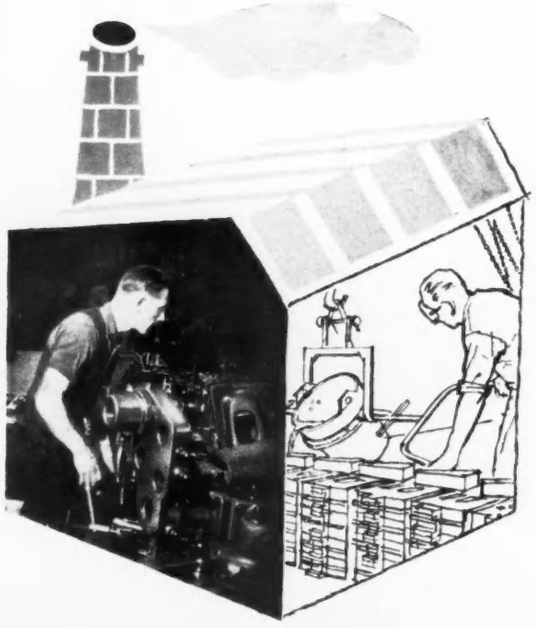

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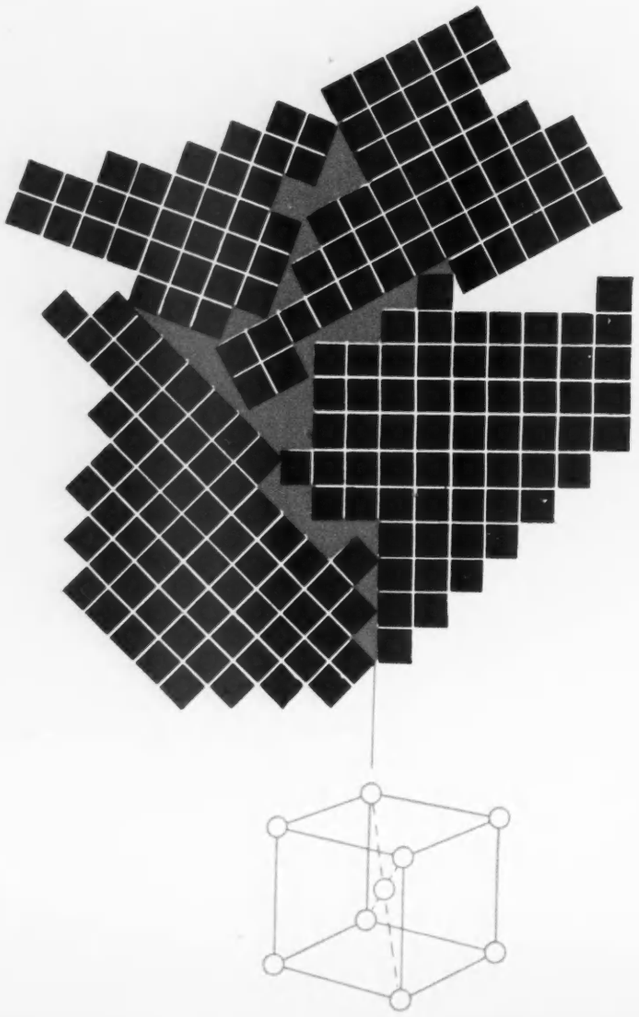

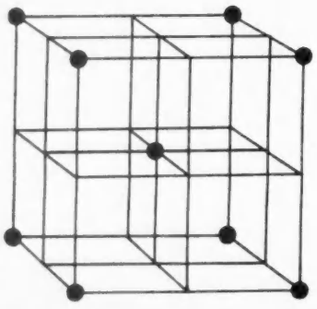

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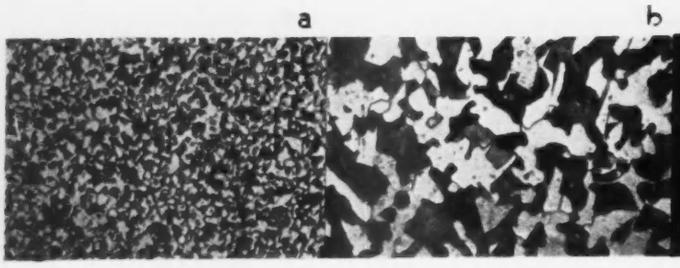

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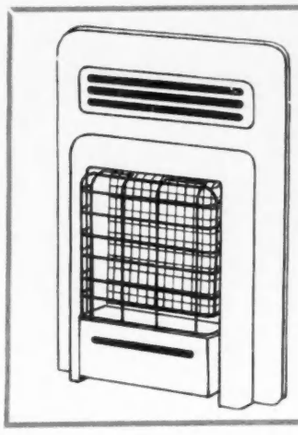

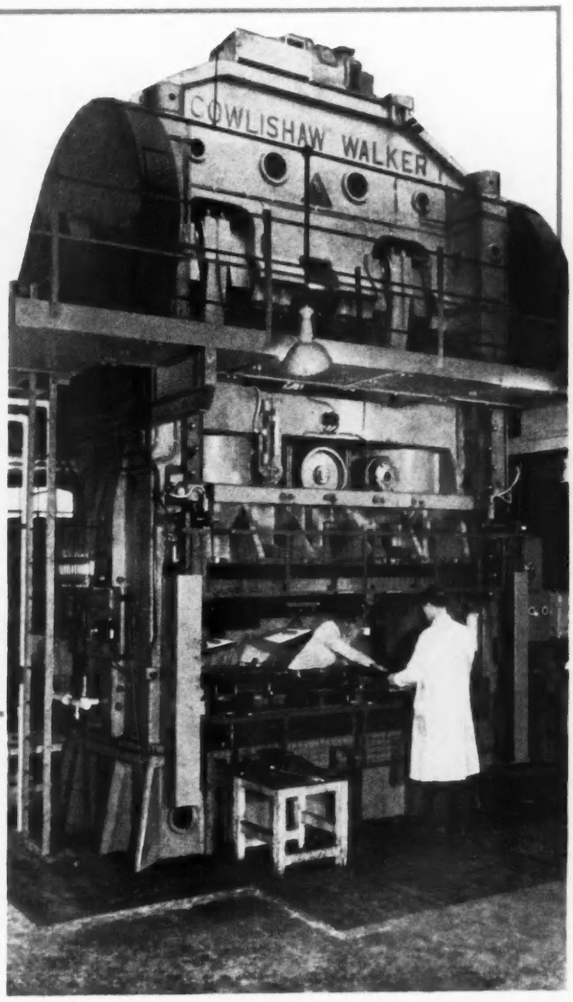

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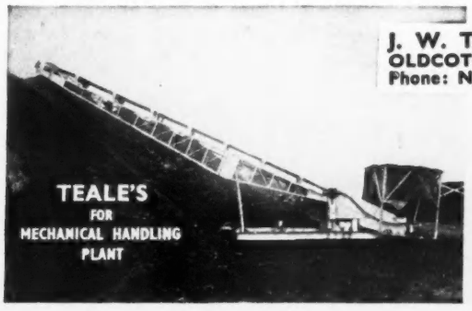

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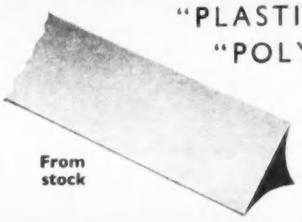

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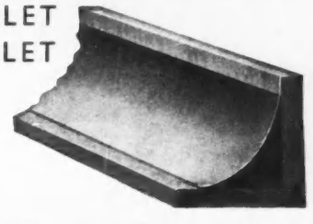

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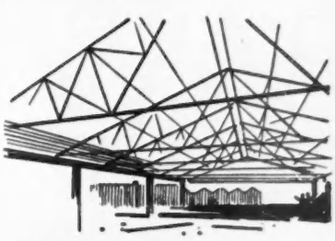

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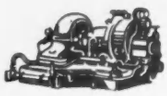

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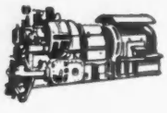

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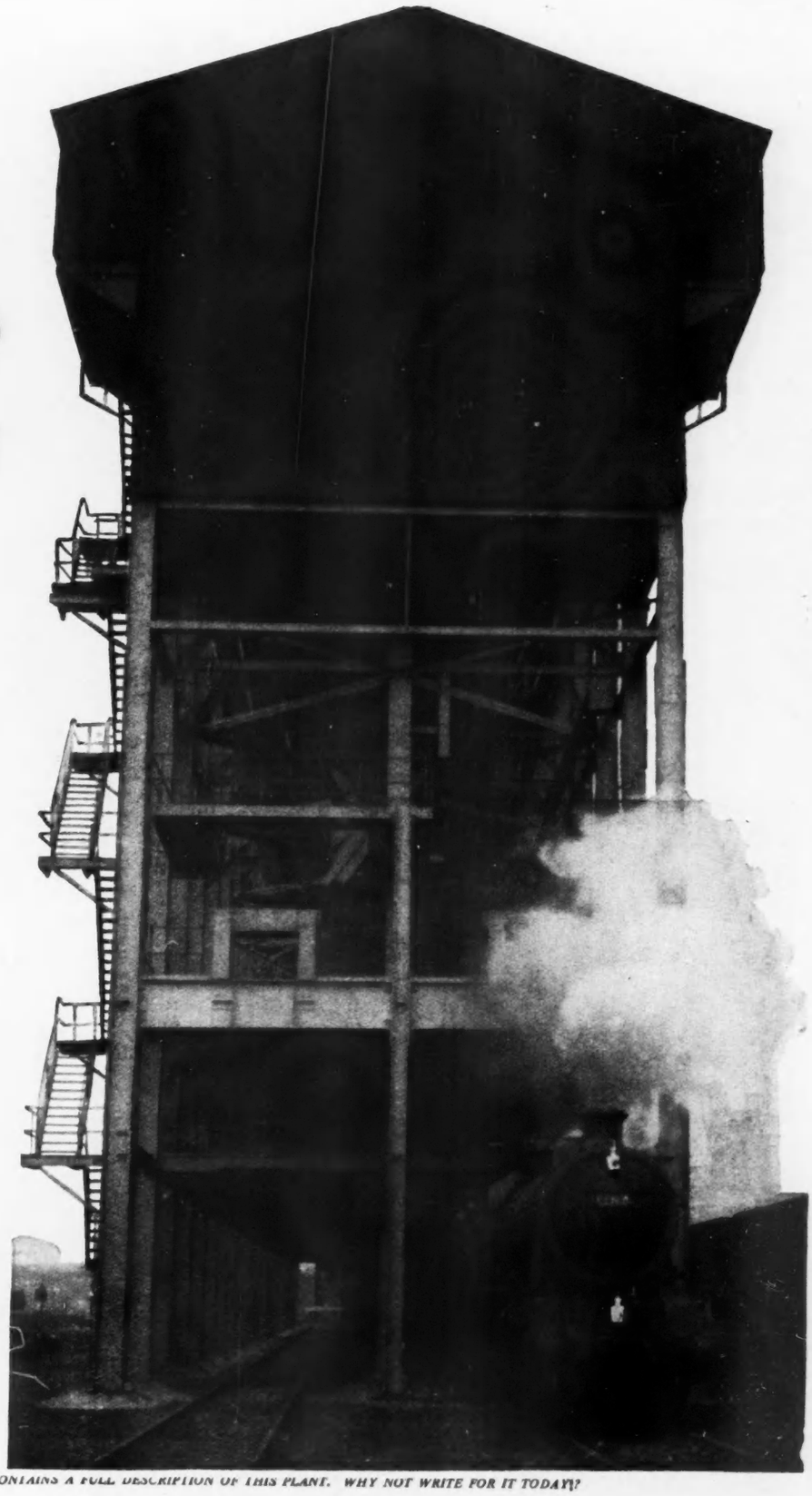

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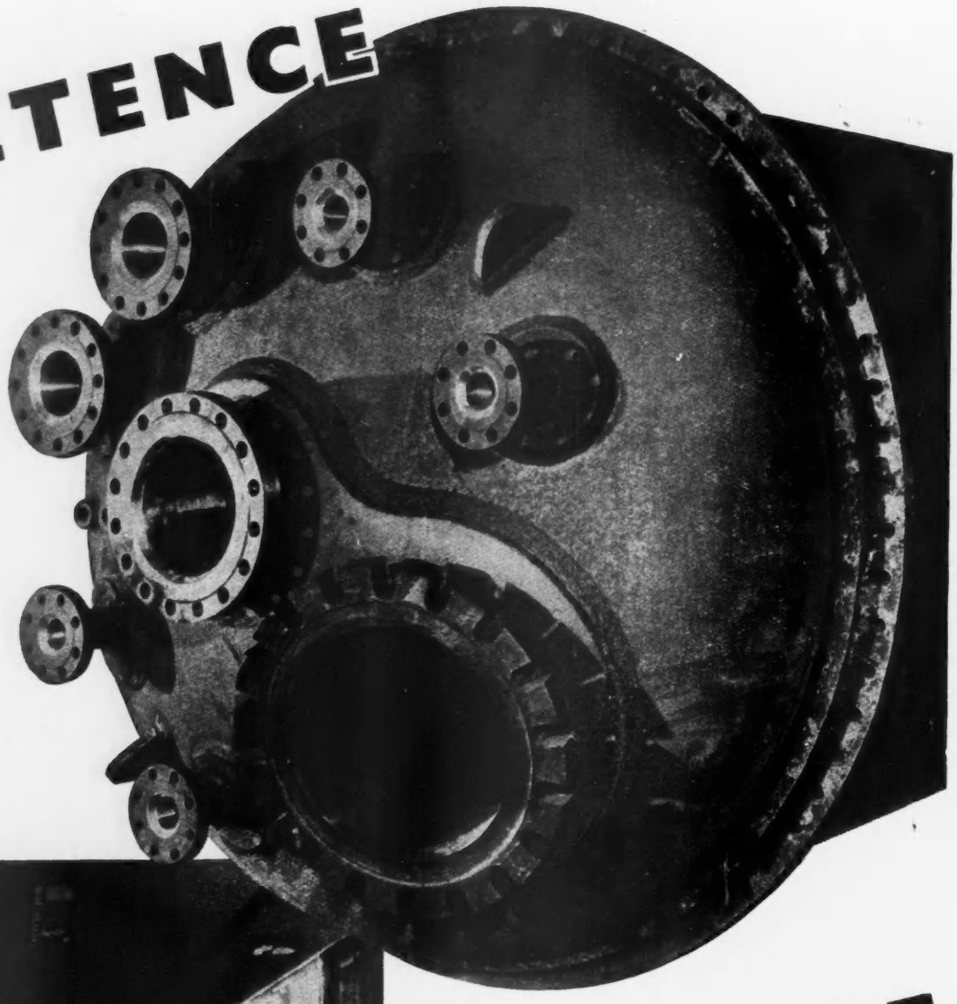

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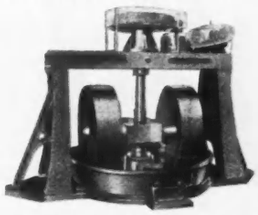

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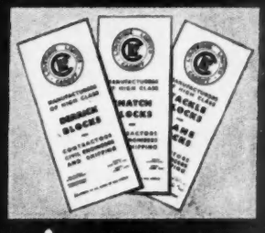

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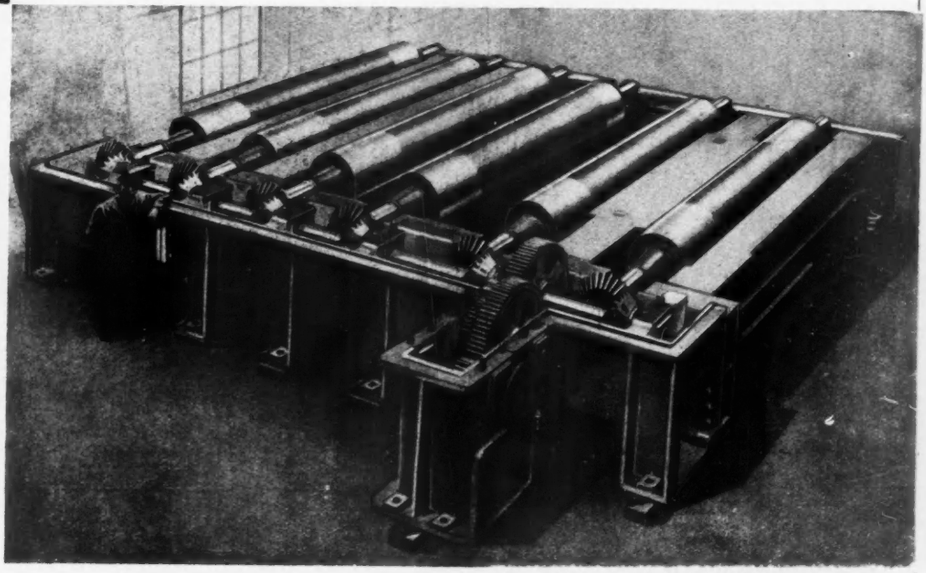

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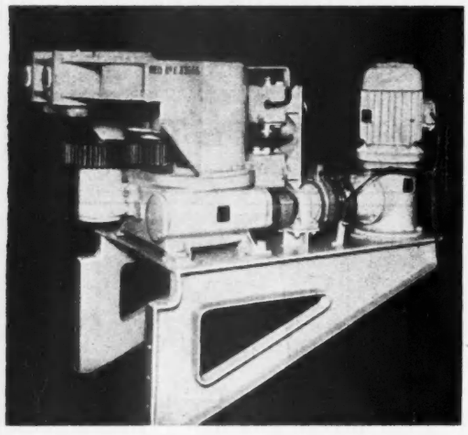

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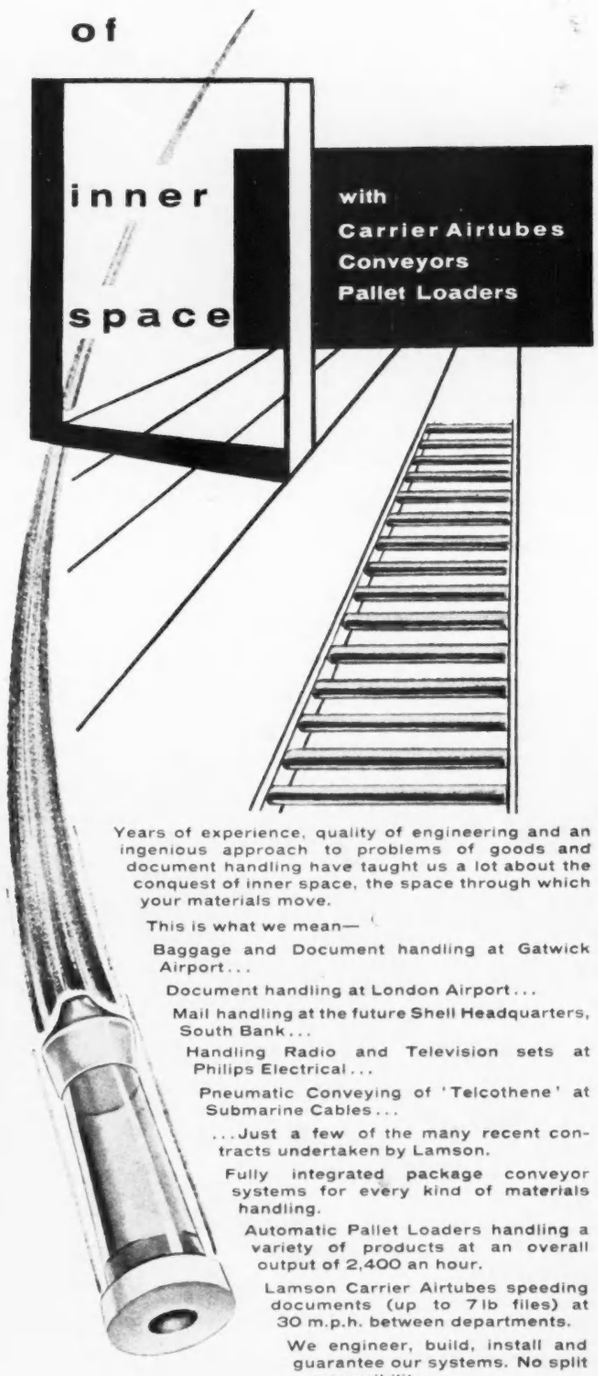

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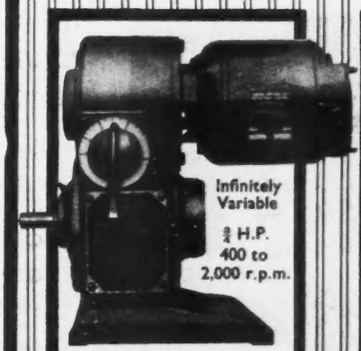

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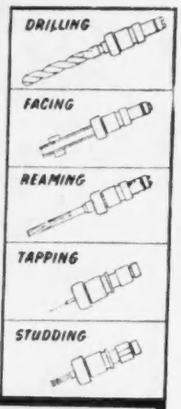

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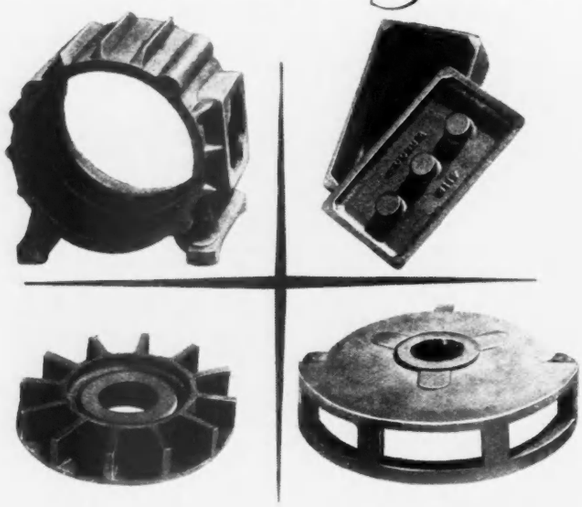

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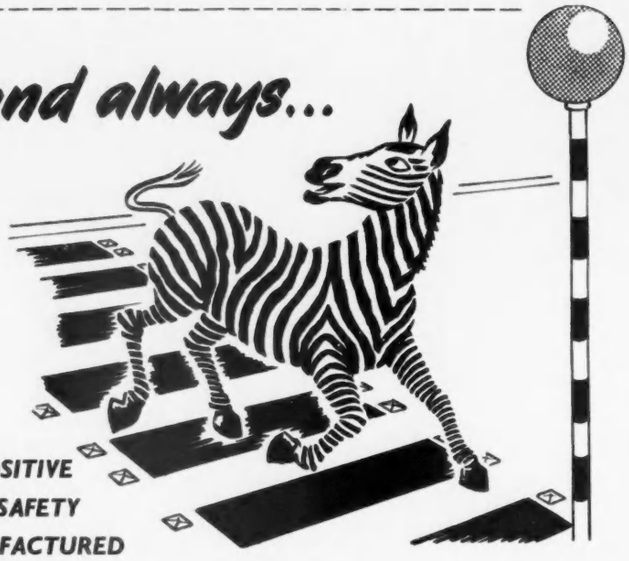

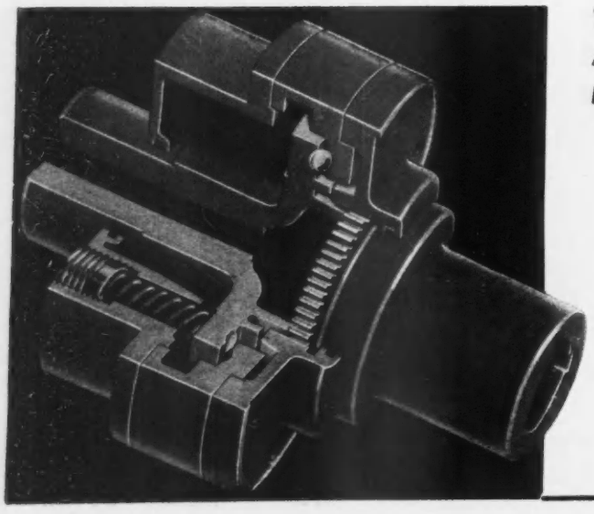

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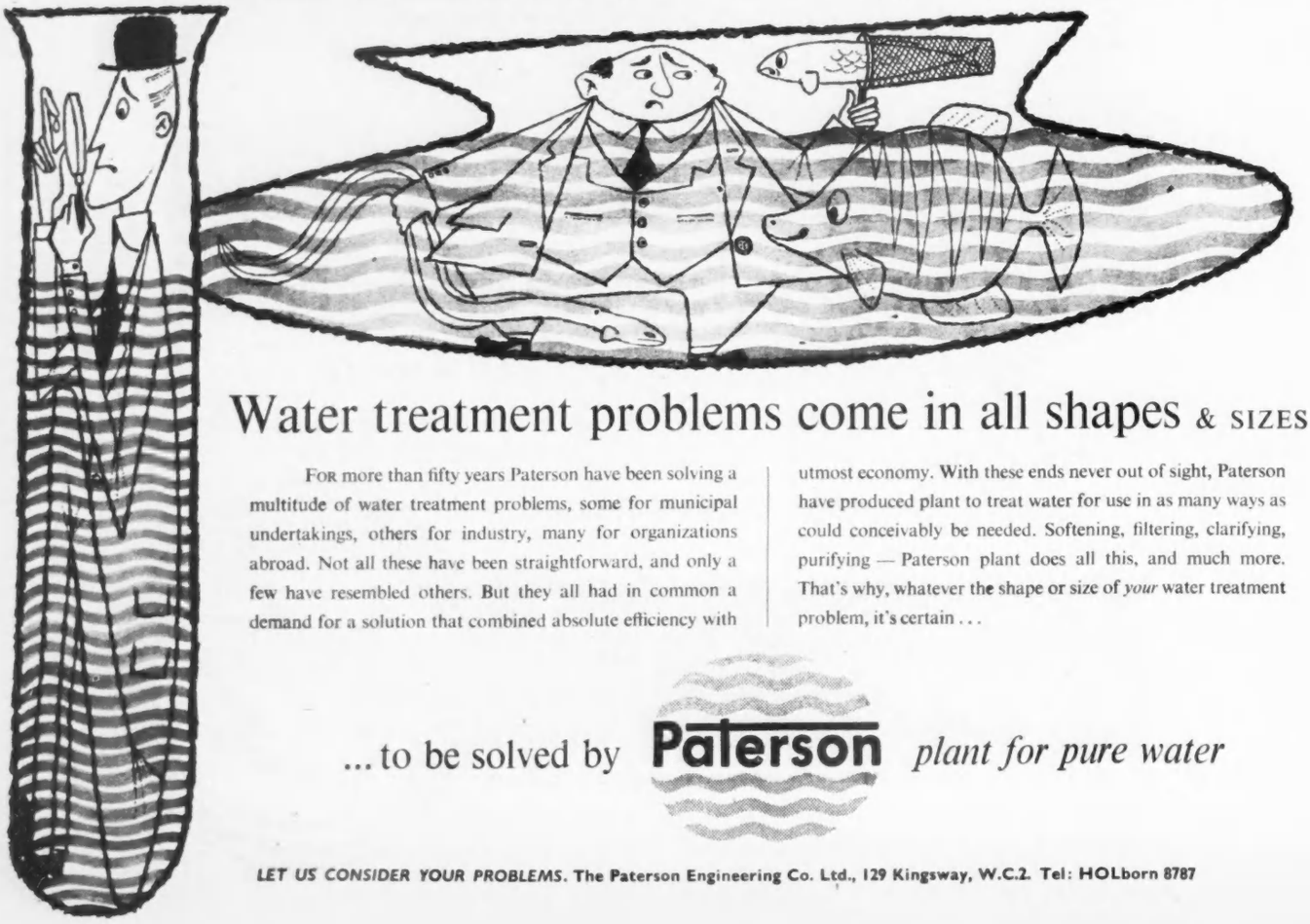

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THE ENGINEER

No. 5382 **MARCH 20, 1959** VOL. 207

BRITISH STEEL

The Iron and Steel Board's latest production statement, which is summarised on page 470 of this issue, gives no indication that the demand for steel is strengthening. The average weekly output of ingots in February was 349,000 tons, which was 9000 tons below the January figure and 78,000 tons below the average for February last year. But, as the Board explains, there was a strike at one steel plant last month and there were some " mechanical difficulties," so that too much should not be read into the marked difference between the January and February production totals. There are other figures in the statement which must be noted; particularly those which show that throughout last year steel users and merchants continued to run down their stocks. During the final quarter of last year, for example, steel stocks declined by 487,000 ingot tons, compared with a fall of 368,000 ingot tons in the third quarter. Nevertheless, it is estimated that, after allowing for the fall in stocks, home steel consumption in the final quarter of last year was 12·4 per cent below that in the comparable quarter of 1957. It is unlikely that consumption has fallen further in the first two months of this year, but it certainly has not risen appreciably, with the result, of course, that the British steel industry is still operating some way below its installed capacity. The latest information on this point suggests that not more than 75 per cent of the available production capacity is at present employed.

The deterioration in the demand for British steel, which has been evident over the last eighteen months or so, has in no sense seriously affected the development programme on which the industry is now engaged. According to a survey made by the Iron and Steel Board, the industry's capital expenditure last year on modernisation and development projects amounted to £105 million ; the highest annual expenditure previously was £95,000,000 in 1957. Capital expenditure this year, it is estimated, will not be less than it was in 1958. The timing of some of the modernisation projects already in hand has been subjected to amendment and the lower demand for steel has led to the closing down, somewhat sooner than would otherwise have been expected, of some older production plant with an annual ingot capacity of about 500,000 tons. Nevertheless, it is anticipated that by 1962 there will be production capacity for about 28,000,000 tons and, if the demand warrants it, there is good prospect that output in excess of that capacity will be possible. By the following year, and to an increasing extent thereafter, the two new strip mills which are to be built in Scotland and South Wales should be making a substantial contribution to the country's steel output. When the Prime Minister announced last November that it had been decided to proceed with those projects, he indicated that if financial assistance should be needed which could not be met from the resources of the two companies concerned, the " necessary amounts would be advanced by the Government." Arrangements for Government assistance in the strip mill projects have since been made. Colvilles, Ltd., is to borrow up to a maximum of £50,000,000 in aid of the new strip mill in Scotland and, last week, the Minister of Power stated that agreement had been reached in principle with Richard Thomas and Baldwins, Ltd., under which the Government would lend up to £60,000,000 towards the construction of an integrated steel works, including a semi-continuous hot strip mill, on a site near Newport, Mon.

With these and other capital projects which are in hand, it does not seem to us at all likely that the British steel industry will be unable to meet the future demand for its products. At present, the demand is weaker than at any time since the war, but it is not unreasonable to hope that the bottom of the minor recession has been reached and that in the coming months a resurgence will become more and more evident. The British steel industry, organised as it now is under private ownership with a reasonable measure of public oversight, is in no sense failing in its national responsibility ; it continues willing to invest millions of money in capital projects and technical development. Recently, *The Spectator* has published the report of an independent commission which it appointed " to inquire into the advantages and disadvantages of the nationalisation of the steel industry." Among its conclusions, this commission says that it is impressed by the strength of the argument (advanced in favour of nationalisation) that the steel industry should have a margin of productive capacity in excess of that needed to meet the estimated demand at any particular time. It goes on to express " considerable doubt whether the industry is willing or prepared to accept this obligation as a matter of general policy." It seems, the commission comments, that the industry " is prone to allow short-term consideration (such as the current recession) to affect unduly its long-term plans." As we look again at the post-war record of the British steel industry and at the way in which it is facing its present and future responsibilities, we can find no ground at all for endorsing this particular pronouncement by *The Spectator* commission.

TELEPHONE SERVICE PROPOSALS

Fortunately for the future of the telephone in this country, the recent report on " Telephone Service and the Customer " goes further than might be gathered from the volume of comment which has appeared in the lay press on its proposal that " operators should be less formal and more helpful." The document presents the conclusions of a team consisting of two Post Office and two trade union representatives which visited the U.S.A. last November to study the objectives and methods of the operating, manufacturing, advisory and research organisations comprised in the Bell System. A characteristic observed, and one which " underlies everything the system does," is the desire to please the customer. Consequently, much effort is spent on survey and planning to try to predict what developments will best please the customer and meet his needs, and substantial field trials are undertaken at an early stage in planning. Later, the

system goes out of its way to help the customer use the service he gets. The team mentions the effort put into preparing the public for new facilities such as direct distance dialling (corresponding to subscriber trunk dialling). This is of particular interest at the present time, in that S.T.D. is already in operation at Bristol and new items of equipment for private subscribers and public call boxes have been designed. We have noticed limited references to forthcoming facilities such as trunk call meters for clubs and hotels, and " pay on answer " call boxes, but presumably not on the scale implied by the " wave of publicity " with which the Bell System is said to herald new facilities. There will be an opportunity to show how much importance is attached to this aspect of the report when, on April 6, the new code " 100 " for calling the operator replaces the familiar " 0 " in the London Region as a very early forerunner of S.T.D. procedure.

With regard to the steps already being taken to make the telephone service in this country a personal service to meet the customers' wishes, the relaxation of rules governing the phrases used by operators may be helpful if observed with moderation. Set phrases have the advantage of being easily recognised, and it is probably just as important that accepted formulæ should not be gabbled, or uttered as if they were invective, as that they should be replaced by words spoken from the heart, however well modulated in delivery and elegant in content. A more important decision is to undertake methodical and regular surveys of public opinion. This is a complement to the third step of designing more new facilities and giving them preliminary trials to see if customers want them. The report rightly emphasises the growing importance of such procedures as mechanisation proceeds and the customer has to deal more and more with apparatus which cannot adapt itself to his wishes in the way people can. The appropriate expenditure of effort on mechanisation schemes itself deserves study, for in the U.S.A. the person-to-person call service controlled by operators (corresponding to the personal call here) accounted recently for 45 per cent of business and 25 per cent of residence calls, and, as noted in the American Section of our March 13 issue, proposals have been made for extending this distinctly personal service by issuing subscribers with pocket radio receivers through which they may be run to earth by cruising radio cars wherever they may be.

" POST-PLANNING " LONDON'S ROADS

The L.C.C. is holding an exhibition at the County Hall called " Road Works Ahead," where models, photographs and so on, of road improvements in the County of London may be seen. The L.C.C.'s present programme of new construction involves a total cost of £40,000,000 for some fifty schemes already completed, twenty-eight in progress, and thirty-two more due for the next few years. The following figures illustrate the position : improvements completed £5,000,000 ; current rate of expenditure £3,000,000 a year ; improvements under construction (total) £8,000,000 ; rate of annual expenditure in 1959–60, £5,000,000. All these figures are for gross expenditure and include property costs. The Council's 1951 development plan is at the root of this work ; the plan envisages a limit of capital expenditure for all purposes of £27,000,000 a year for twenty years, and expenditure for road improvements over the same period of £4,000,000 a year. The " ultimate road pattern " envisaged in this plan and corresponding to the total of £80,000,000 spent over twenty years comprises the following improvement schemes : six intersections on the flyover principle ; thirty-seven intersections on the roundabout principle ; 11 miles of new principal traffic roads ; 7 miles of major widenings of existing routes ; 2 miles of new tunnel ; the rebuilding of two Thames bridges, and a river wall. In summing this up, however, the L.C.C. states that " within the framework of national economic policy, the Government has only recently been able to approve expenditure on road schemes approaching the level of the development plan proposals," though expenditure at a rate of £7,000,000 a year for four years is now contemplated, apparently after the 1959–60 period.

It must be recognised immediately that any road improvement scheme envisaged in London is almost bound to be fraught with difficulty. The schemes shown at the exhibition—most of which are by now quite well known—demonstrate that considerable ingenuity has been used in devising them, and the marrying of new road layouts with new building construction, all with a minimum of interference with existing buildings, has been excellently achieved. To all of this we pay tribute. But, equally, it seems evident to us, that the principles governing these road improvements are fundamentally in error. The policy of this whole programme has been to use very limited funds to iron out the worst faults of the existing road system. The " ultimate road pattern " of the development plan is thus, overall, virtually the same as the one that exists to-day, with improvements here and there at junctions and similar places. This " ultimate road pattern " would probably serve adequately for pre-1951 traffic. It is an example of a type we have called " post-planning " (i.e. it suits a situation existing prior to the plan), a term which has at least equal etymological justification, we hope, to that common horror of contemporary jargon, " pre-planning."

With a policy of this kind, fears are at once felt that it will, in the long run, and in relation to the improvements in traffic flow which it gives, prove excessively costly. Most of the views expressed on occasions such as the 1956 conference on urban motorways support this view. If any noticeable improvement is to be achieved in London's traffic conditions, to say nothing of preventing further deterioration, a policy of a different order of magnitude from the present one is needed. The economic benefit of large expenditure on roads is becoming more and more recognised. Nowhere is this more true than in London, where a road programme greatly expanded in size and greatly modified in principle would have a vastly stimulating effect on the whole economy of the metropolitan area. The assumption made at the L.C.C.'s exhibition that such an approach is ruled out in the London area cannot be accepted. The advantages, both economic and humanitarian (since the separation of pedestrian and motor traffic is fundamental to road safety), from good road travel would be immense. As we have said before, and will probably say many times again before the truth is recognised and acted upon, the problem should and can be faced on the basis of providing for the foreseen growth of traffic. To evade the issue by claiming that the expense cannot be afforded is merely to be irresolute.

TOO LITTLE TOO LATE

Last Monday a mile-long relief road for Newbury in Berkshire was declared open. The event draws attention to the fact that a number of the road improvements now being carried out in various parts of the country are examples of that post-planning to which we refer in the immediately preceding article. They are likely to prove out-dated even before completion. We do not know but we suggest that this relief road at Newbury

which will carry traffic round a bottleneck in the town was first thought of before the war. Indeed, if it had been in existence since, say, 1935, it would by this time fully have justified itself. But now, in 1959, much of its value has gone. For though it is still true that a short length of narrow road called Oxford Street in Newbury has heretofore had to carry all the east-west traffic of the Bath Road A4 and in addition all the north-south traffic on the Winchester-Oxford route A34, thus creating a bottleneck, which the new road will relieve, in fact a whole length of road some 10 miles long between Thatcham on the east and Speen on the west of Newbury will very soon need to be by-passed and, indeed, parts of it, especially at Thatcham and Speen, urgently need the by-pass now. In the longer run it would surely have proved cheaper to have built this long by-pass than to do too little too late in piecemeal fashion by building the shorter one. At how many other places in this country, we wonder, are there such limited schemes originally projected long ago which, it would become clear upon re-examination, have become out of date through delay in obtaining approval for their construction ?

ROAD TAXATION AND THE BUDGET

Regularly each year the British Road Federation, at about this time, suggests to the Chancellor of the Exchequer that he might reduce road taxation. This year, no doubt, it does so with more hope than for several years past that something quite substantial might come of it. For if there is to be any reduction of taxation this year—and economists, for once in agreement, all seem to think it would be justified—then cuts in road taxation should stand high in preference to certain other possible items on the Chancellor's list. The case is particularly strong for the abolition of purchase tax at 30 per cent on commercial vehicle chassis ; for this is an anachronistic tax on industry's capital requirements. It can, of course, also be argued that the motor fuel duty, standing now at 2s. 6d. per gallon is somewhat anachronistic. In so far as it goes to meet expenditure on the maintenance of roads, or even, in addition, capital expenditure upon improvements and upon new roads, it can be regarded as justifiable. But, in fact, the yield far exceeds such expenditure, so that the excess is a direct, and surely an undesirable, tax on transport. However, taxation of road vehicles stands at so high a level and provides so substantial a proportion of the whole revenue that it would be quite unreasonable to suppose that it could be almost done away with. Even the British Road Federation proposal that the fuel tax should be cut from 2s. 6d. down to 1s. 6d. per gallon is probably optimistic. Yet so buoyant is the revenue from road taxation that, as the Federation points out, even if the fuel tax were cut by 1s., purchase tax on commercial vehicle chassis abolished and purchase tax on cars reduced to 30 per cent, road taxation could provide over £250 million per year to the general revenue and cover also road expenditure rising from £108 million in 1960 to £247 million in 1965. The Treasury, of course, will look askance at such estimates, based as they are on a 6·5 per cent annual increase in the number of motor vehicles licensed in Great Britain. But the Federation believes them to be conservative in the light of figures calculated by the Road Research Laboratory of the rate of increase since 1946. Yet in one way we think even the Treasury must be impressed. Unless tax reductions are soon made the figures make it very clear that within a comparatively few years road users will be contributing a quite unreasonably high fraction of the total national revenue. Why should they ?

ON IGNORING INSTRUCTIONS

One of the portents of our age is the advent of magnificent manuals and instruction books supplied by manufacturers about the devices which they make. They look attractive, they contain a wealth of information ; and it is a pleasure to feel one ought to study them. But what happens ? As often as not, regrettable though it may seem, the instructions are wholly ignored ! Is it we wonder a sad or a glad commentary upon human nature that many people—perhaps most people—would much rather, boldly, " have a go " than embark upon the intellectual labour of attempting to understand the simplest of instructions. After all it often is much quicker to ignore them ; and, for a time at least, engineering devices are surprisingly tolerant of maltreatment. Sometimes, however, it does not pay off. Victory is not always to be obtained by putting a telescope to one's blind eye. A little note reached us last week from Megator Pumps and Compressors, Ltd., relating to the starting of a diesel-driven fire pump on board a ship. The firm's representative who was called in to solve the problem reported : " Several fitters had sprained wrists, others had lost the use of their right arms. I was told that the man who formerly had exclusive rights to this job had broken his right wrist in a previous ship. Undaunted by this setback he proceeded to swing with his left arm and broke his left wrist." Fortunately the firm's representative, unlike this collection of people, had read the instructions (which were indeed simple enough to understand) so that under his ministrations the engine roared into life without any difficulty at all. We suppose an old old moral applies even to modern machine operators and the most attractive of instruction manuals. You can take a horse to the water but you can't make him drink.

The Engineer—100 Years Ago (MARCH 18, 1859)

" Coal-Burning Locomotives "

" Upon the 9,500 miles of British railways there are now employed more than 5,000 locomotives, performing an annual mileage of upwards of 90,000,000 miles. The fuel consumed by these engines may be taken as equal to 1,500,000 tons of coke yearly, requiring for its production nearly 2,500,000 tons of coal. This quantity of fuel may be valued at £1,200,000. Were coal to be established for coke, so as to accomplish equal evaporative results, pound for pound, the cost would not exceed £700,000, leaving a clear saving of £500,000. . . .

" The plan proposed by Mr. Clark for the combustion of coal in ordinary fireboxes, and tried by him upon the North London, Eastern Counties, and South-Eastern Railways, consists in inducing currents of air by means of slight jets of steam injected through openings in the sides of the firebox, at or near the level of the fire. . . . On the North London Railway, an engine with medium sized firebox and large chimney was fitted with four steam jet nozzles of one-sixteenth of an inch diameter each, these being directed through as many openings into the firebox, just above the surface of the burning coal. Mr. Clark states that by these means, and with hard coal, smoky enough in itself, all the products of combustion were carried off, and smoke banished from the chimney top by the natural draught of the boiler when the steam was shut off, and without the aid of the blow-pipe in the chimney. In subsequent trials upon the Eastern Counties Railway, the consumption of coal, as compared with that of coke burned in the same engine, was but 7 per cent. more per ton gross per train mile, whilst the evaporation, which was 7·36 lb per pound of coal with cold feed-water, was but 5 per cent less. . . . It is a great merit of this plan, if continued experience shall confirm its success, that it involves no structural alteration of the ordinary boiler, being applied quickly and cheaply and requiring little care in its management."

Advances in Steam Turbines for Marine Propulsion

By A. D. SOMES*

A paper, which was read before the Institute of Marine Engineers on March 10 and of which we publish an abstract, considers advances in the design and construction of steam turbines for the propulsion of ships growing out of present-day trends in the construction and operation of merchant ships. The effects of increases in power and steam conditions, and changes in classification rules, are examined and assessed in relation to the turbines. New concepts and methods in design are discussed and experience with advanced designs is indicated. Finally, some examples of actual details of construction developed to meet new conditions are presented.

SHIP construction is being acted on by the same economic and competitive forces that are continually pushing all forms of transportation equipment to greater carrying capacity and speed. Over the past twenty years, the power of propulsion machinery for merchant ships has increased to match the progressive increase in displacement and speed. During World War II, the major portion of the ships were dry cargo ships of 6000 h.p. and 8500 h.p. Shortly after the war, the Esso Zurich and Esso Suez class of tankers were built with increasing power up to 17,500 h.p. normal rated power. The recent Esso Gettysburg class and the National Bulk Carriers Universe Apollo class tankers have 25,000 h.p. propulsion turbines.

When shipbuilding activity in the United States revived in the late 'thirties, the electrical utility industry had advanced rapidly from steam conditions of 400 lb per square inch gauge and 700 deg. Fah. in the early 'thirties to pressures of 800 lb to 900 lb per square inch gauge and temperatures of 800 deg. to 900 deg. Fah. The merchant ship designers chose 440 lb per square inch gauge and 740 deg. Fah., and these conditions continued until 1946.

After 1946 new merchant ship construction used 600 lb per square inch gauge and 850 deg. Fah., and has continued with this pressure and temperature even though turbine powers have increased from 12,500 to 25,000 s.h.p.

Power plant heat cycles for ocean-going merchant ships fall very nearly into a single pattern and there seems to be no present trend to depart very much from it. Except for small ratings, steam conditions are near 600 lb per square inch gauge and 850 deg. Fah. at the boiler and 1½in Hg. abs. in the condenser. The feed water heating system uses two feed water heaters supplied with steam taken from the turbines, an economiser and a steam air preheater. Steam to the low pressure heater is taken from an intermediate stage of the low pressure turbine and that to the high pressure heater from the crossover between the two turbines. This pattern has not changed in ten years and is now being used for power plants with normal ratings of 25,000 h.p.

This situation seems to conflict with advances in steam power plants in other fields and has initiated re-examination of the marine power plant to be sure that all factors have been fully assessed. One study[2]† of a 25,000 h.p. power plant for tankers indicates that the optimum steam conditions for maximum return on the investment is 600 lb per square inch gauge and 860 deg. Fah. Contributors to the discussion on this paper concluded that steam conditions should be no lower than 850 lb per square inch gauge and 950 deg. Fah. and might well be 1200 lb per square inch gauge and 950 deg. Fah.

Review of the long term results of a large number of advanced design projects in the field of power generation has convinced the author that target points should always be selected beyond the optimum predicted by analyses made at the time of decision and particularly so when a definite step in progress appears imminent. Otherwise, to-day's rapid advance in technology may quickly make the equipment obsolete.

Fig. 1 shows the result of a study of the effect of steam conditions and cycles on all-purpose fuel rate for merchant ship power plants. It will be seen that there is a substantial improvement in fuel rate with steam conditions at 850 lb per square inch gauge and 950 deg. Fah. with four heaters and regenerative gas air heater as compared with 600 lb per square inch gauge and 850 deg. Fah. with two heaters, an economiser and a steam air heater. Overall turbine and gear efficiencies are shown in Fig. 2.

Machinery Arrangement

The two-cylinder cross compound turbine with a single-flow low pressure turbine is the type used for most merchant ships. It is the design preferred for units with normal rated powers from 6000 h.p. to 24,000 h.p. Separation of the turbine into two parts, one for the high pressure section and one for the low pressure section, allows the selection of a speed for each which will give optimum efficiency for the overall unit. The reduced shaft spans between bearings permit smaller shaft diameters with a reduction in gland and packing leakage loss, a further contribution to high overall efficiency.

The single-cylinder single-flow turbine has proved economical for powers below 6000 h.p. A desirable annulus area for the last stage can be obtained with a speed giving a good balance of efficiency of both the high pressure and low pressure sections of the turbine. The lower cost of this design makes it economically feasible for the smaller powers.

For powers of 25,000 h.p. and above, the two-casing cross compound design with a double-flow low pressure turbine retains the advantages of compactness and high efficiency by providing increased last stage annulus area without reduction in speed.

Athwartship position of the condenser is well suited to the cross compound single-flow turbine design. The normal configuration of the low pressure turbine exhaust places the opening with its long dimension athwartship and lengthwise of the condenser. The distribution of steam leaving the turbine exhaust tends to conform to the internal arrangement of the condenser and minimises the distribution space needed over the tube bank. Engine-room space is reduced and performance is improved through a reduction in the pressure loss to the condenser.

A trend developed in the design of early post-war machinery arrangements led to mounting the low pressure turbines directly on the condenser and making the condenser serve as a foundation for the turbines. The advantages anticipated were : (*a*) a potential

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† References are as in original.

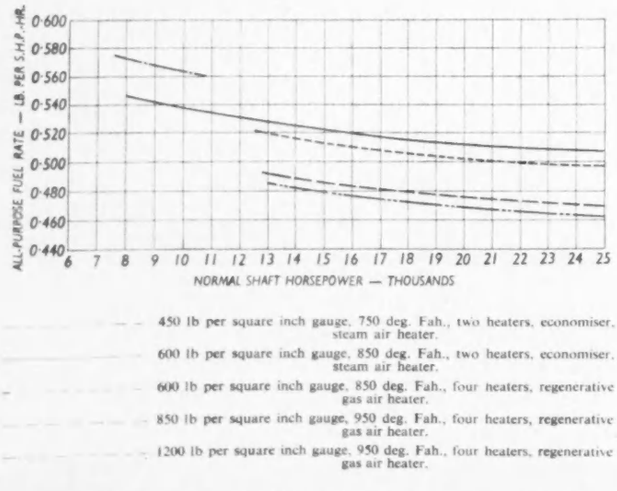
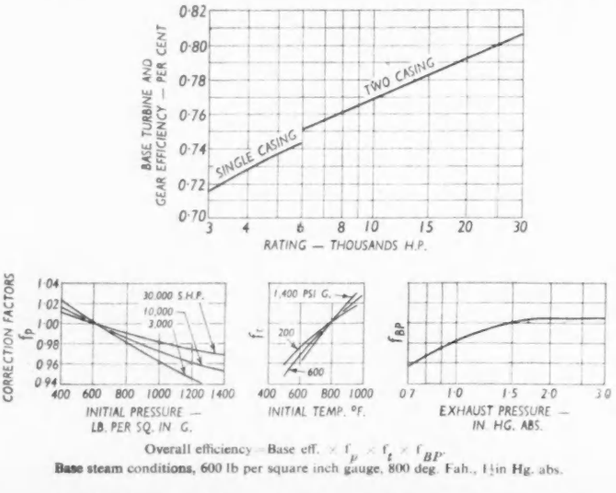

ALL-PURPOSE FUEL RATE — LB. PER S.H.P.-HR.
0·600
0·580
0·560
0·540
0·520
0·500
0·480
0·460
0·440
6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
NORMAL SHAFT HORSEPOWER — THOUSANDS
450 lb per square inch gauge, 750 deg. Fah., two heaters, economiser, steam air heater.
600 lb per square inch gauge, 850 deg. Fah., two heaters, economiser, steam air heater.
600 lb per square inch gauge, 850 deg. Fah., four heaters, regenerative gas air heater.
850 lb per square inch gauge, 950 deg. Fah., four heaters, regenerative gas air heater.
1200 lb per square inch gauge, 950 deg. Fah., four heaters, regenerative gas air heater.

Fig. 1—Effect of steam conditions and cycle on all-purpose fuel rate



Overall efficiency = Base eff. $\times f_p \times f_t \times f_{BP}$

Base steam conditions, 600 lb per square inch gauge, 800 deg. Fah., 1½in Hg. abs.

Fig. 2—Overall efficiency of marine propulsion turbine gear units

gain in sustained efficiency of the turbines by freeing the finely made moving machinery from carrying the dead load of static equipment ; (*b*) a saving in the overall cost of the machinery by converting the normal structure of the condenser into a suitable foundation for the turbine with simple modifications to increase strength and stiffness ; (*c*) a simplification of the gear casing by removing the load of the low pressure turbine and condenser from it.

Increased misalignment between the turbine shafts and high-speed pinions was anticipated due to greater expansions and to weaving of the ship. However, experience with a new tooth form for the dental type flexible coupling and extended distance pieces had shown that these couplings would easily accommodate the misalignments expected. The tips of the external teeth on the distance piece are machined to conform to a spherical surface. The elements of the tooth surface are not straight lines parallel with the axis but are slightly curved to form a barrel shaped tooth. The balled top of the external teeth on the distance piece centres the coupling in the coupling sleeves on the turbine and pinion shafts. The relief of the tooth form permits the coupling to accommodate limited angular motion with normal tooth contact. These couplings have been very successful and are now used with all propulsion turbines and gears without regard to the method of support.

Turbines

A trend toward a single type of turbine for land turbine generator units has been under way in the United States for some time. Generally, all builders are now offering impulse turbines with wheel and diaphragm construction for all powers up to a maximum output equivalent to 25,000 h.p. Those builders who have made extensive use of reaction construction have changed to impulse designs. The trend will undoubtedly continue and will in time expand to include larger powers and other applications. Because developments in land turbines have forecasted trends in design for marine turbines, this trend is of interest to marine turbine users.

At the present time, the individual builders of propulsion turbines for merchant ships use different proportions of impulse construction. All use impulse designs for the first stage in the ahead turbine, in the form of a one-row or a two-row wheel, and also for the astern turbines. The remainder of the ahead turbines vary from all-impulse to all-reaction.

The excellence of turbines as well as other components of the complete propelling plant can be assessed in terms of safety, reliability, first cost including installation, efficiency as a measure of the direct effect on fuel cost, and maintenance cost. It is dependent on the adequacy of the design and construction to meet not only the requirements of normal service, but also the unexpected and abnormal.

The severest duties on all parts of the turbines occur during the crash ahead and crash astern manœuvres from a full speed condition in either direction. The time interval from full turbine speed in either direction to full speed in the opposite direction will be between twenty and thirty seconds. During these operations, many parts of the turbines must adjust to large transient, and, subsequently, large steady state temperature differences.

Changes in design details for turbines operating at higher pressures and temperatures are related primarily to the effects of temperature rather than effects of pressure. Material sections increase with pressure and the higher density of the steam increases surface heat transfer rates. Both effects lead to increased temperature gradients in the structure and proportionately larger expansions and stresses. To these must be added the much greater effects produced by higher levels of operating temperature which further increase steady state and transient temperature differences.

Suitable alloy additions can substantially offset the decrease in strength of materials at higher temperatures. A departure from conventional design is indicated to hold stresses at suitable levels without sacrificing the simplicity of construction characteristic of machinery for lower pressures and temperatures.

One solution is to modify the construction for the lower steam conditions to retain its advantages and yet allow for the more severe duty : first, by proportioning the rotating and stationary parts to minimise differential expansion between them ; secondly, by removing points of restraint in the structure and allowing free but guided expansion of parts, and thirdly, where restraint cannot be removed, by providing increased flexibility in the members to reduce total stress.

These principles have been applied to the design of land steam turbines operating with steam conditions up to 1450 lb per square inch gauge and 1000 deg. Fah., and propulsion turbines for the Navy operating with steam conditions up to 1200 lb per square inch gauge and 975 deg. Fah. In these particular applications, temperature differences were further increased by the action of sequentially operated steam control valves arranged in a valve chest integral with the main turbine casing. Service experience has fully demonstrated the soundness of the design.

These same design principles have been applied to turbines developed for operation on merchant ships with steam pressures and temperatures above 600 lb per square inch gauge and 850 deg. Fah.

The turbines use impulse design with wheel and diaphragm construction throughout. With higher pressures and temperatures this design offers many advantages. The impulse design gives better efficiency with the smaller nozzle areas needed for the higher density steam. The axial thrust load is small enough to avoid special equalising means with the associated leak losses. The small shaft diameter keeps leakage losses small and transient expansions have less effect on them. With the gashed rotor, the relative rates of expansion of the rotor and casing can be better matched by proper proportioning and axial clearances set at more favourable values even though axial clearances have a minor effect on efficiency.

From the standpoint of simplicity, it is desirable to retain the main valve chest for the hand valves as an integral part of the upper half of the high pressure turbine casing, by providing means of coping with the greater expansions. Experience at the higher steam conditions had shown that the usual construction with the chest, nozzle passages and the outer walls of the head in one solid structure down to the horizontal joint in the casing, would make it difficult to maintain a leak-free joint across the forward wall of the head. The steam passages from the valves to the nozzles were formed into a separate structure and were freed from the outer casing walls at the front and sides except for the attachment at the floor of the chest. This will be clear if one visualises walking completely around the outside of the steam passages just below the floor of the valve chest where the valve seats are located. Vertical keys are placed at the level of the horizontal joint to guide the lower ends of the steam passages and hold axial alignment. This inner structure is thus free to expand radially in all directions.

Having been separated from the relatively strong structure formed by the nozzle passages, the main casing walls at the sides and front between the floor of the steam chest and the horizontal joint can be proportioned and contoured to accommodate the greater expansion of the steam chest due to its higher temperature, as well as performing the primary function of containing the pressure.

The diaphragms are complex structures with large surfaces presented to the surrounding steam in relation to the mass of its various parts. In addition, the steam in contact with the surfaces is at quite different temperatures. Consequently, the diaphragms expand and contract very rapidly in response to the varying temperature arising during speed changes. Each one acts differently because each has different proportions.

Each diaphragm needs to be free to expand radially and yet be held in close alignment with the shaft to keep packing clearances to a minimum for reasons of efficiency. This is accomplished by radial centre line supports. Each half is carried near the horizontal split by lugs bolted into recesses in the casing joint surfaces and projecting into slots in the diaphragm. A slot in the diaphragm at the bottom fits over a key attached to the casing. The upper half of the diaphragm is keyed to the lower half to hold the two in alignment. Adjusting screws in the diaphragms bear on the lugs and are set to bring the diaphragms central with the shaft. The diaphragm is free to expand but stays in close alignment with the shaft. Measurements of packing wear in many machines show that this arrangement is effective.

The inner packing rings of the high pressure shaft gland in the high pressure turbine that are subjected to high temperature are carried in a separate inner casing which is also centre line supported in a similar manner. These are thus free to expand radially.

The high pressure turbine casing is a steel casting designed to meet all possible operating conditions of the particular service for which it is intended. The material compositions and properties used are given in Table I.

Following semi-finish machining, a hydrostatic pressure test is applied and stresses measured at all critical points by surface mounted wire resistance strain gauges. The test is carried out at room temperature at a test pressure determined from the working pressure and temperature and the material properties by the relation :

$$P_t = 2P_m \frac{\text{Rupture strength at room temperature}}{\text{Rupture strength at working temperature}}$$

Where

P_t = test pressure, pounds per square inch gauge
P_m = maximum working pressure, pounds per square inch gauge.

The low pressure casings are mainly welded structures of plate and bar stock. Material compositions and properties are given in Table I.

The astern turbines are in the exhaust chambers of the low pressure turbines. This arrangement is in operation with steam at temperatures up to 1000 deg. Fah. The steam is taken directly to the astern turbines from the main steam line at full temperature. Operation has been entirely successful and this is a basic design arrangement.

Rotors are the most critical parts of the

TABLE I—*Cast Casing Materials for Marine Turbines*

Material	Medium carbon steel	1 chromium ½ molybdenum	1 chromium 1 molybdenum	2¼ chromium 1 molybdenum
Temperature range, deg. Fah.	775	775–850	800–1000	800–1000
G.E. specification	B50AM380B	B50AM333A	B50AM266A	B50AM269A
Composition :				
Carbon, maximum	0·30	0·20	0·20	0·18
Manganese	0·70 (maximum)	0·50–0·80	0·50–0·80	0·40–0·70
Silicon	0·80 (maximum)	0·30–0·50	0·30–0·50	0·20–0·60
Phosphorus, maximum	0·040	0·035	0·035	0·035
Sulphur, maximum	0·040	0·035	0·035	0·035
Chromium	—	0·85–1·15	0·85–1·15	2·00–2·75
Molybdenum	—	0·45–0·65	0·90–1·20	0·90–1·20
Vanadium	—	—	—	—
Physical properties :				
Tensile strength, pounds per square inch (minimum)	65,000	70,000	80,000	80,000
Yield strength 0·02 per cent offset, pounds per square inch (minimum)	35,000	45,000	50,000	50,000
Elongation in 2in, per cent (minimum)	24	22	18	20
Reduction of area, per cent (minimum)	35	45	45	45

turbines. In addition to being designed with high stresses, variable speed operation imposes variable forces on them through a wide range of frequencies. Coincidentally, resonances may occur with great amplification of stresses and large thermal gradients develop from manœuvring.

All the rotors for turbines being discussed are made with the wheels and shaft integral and are machined from solid forgings. The materials used at different temperature levels

TABLE II—*Forged Rotor Materials for Marine Turbines*

Material	Nickel molybdenum vanadium	Chromium molybdenum vanadium
Temperature range, deg. Fah.	875 (max.)	1050
G.E. specification	B50AM258	B50AM259
Composition :		
Carbon	0·32 (max.)	0·27–0·37
Manganese	0·50–0·80	0·70–1·00
Phosphorus (maximum)	0·040	0·040
Sulphur (maximum)	0·040	0·040
Silicon	0·15–0·35	0·15–0·35
Chromium	1·25 (max.)	0·85–1·25
Nickel	1·75–2·75	0·50 (max.)
Molybdenum	0·40–0·60	1·00–1·50
Vanadium	0·04–0·12	0·20–0·30
Physical properties :		
Tensile strength, lb per square inch (minimum)	105,000	105,000
Yield strength, 0·02 per cent offset, lb per square inch (minimum)	80,000	80,000
Elongation in 2in per cent (minimum)	16	16
Reduction of area, per cent (minimum)	30	30
Impact V-notch Charpy, ft lb (minimum)	12	6
Percentage fibrous fracture transition temperature, deg. Fah. (minimum)	185	250

are shown in Table II. Rotors are delivered as heat treated drum forgings with extensions for the shaft ends and with the surfaces turned for ultrasonic testing.

Beyond proportioning rotors to meet allowable working stresses and factors of safety, attention is given to the proportions that will give excellent operating characteristics at all speeds. These are assessed in terms of low amplitudes of vibration and minimum response to unbalance. This places the first critical speed of the rotors operating in the assembled turbine within the running range.

It was observed long ago that the operating critical speeds were depressed below the predicted values calculated with the assumption of no elasticity at the bearing points. It was also observed that reducing the stiffness of the shaft did not affect adversely the operating characteristics, and the practical effect was to make refinement of balance during final tests of the machines easier. Hundreds of machines are running with the so-called rigid bearing critical below running speed and the overall operating characteristics are indistinguishable from the higher critical machines. Incidences involving the loss of buckets or shroud bands show no differences in operation assignable to the stiffness of the rotors. There is considerable indication that reduced stiffness of the rotor increases its tolerance of abnormal conditions.

No cases of bent shafts have occurred in service. Operating experience indicates that good operating characteristics in normal service as well as the capacity to sustain unusual or abnormal conditions is not dependent on a shaft design that places the first critical on rigid bearings above the running range. Spring backed packings throughout, relief grooves in the shaft at the ends of the packings, and shaft proportions that place the critical speed at a lower point, are the important criteria.

Experimental and analytical investigation of the behaviour of rotors[3] clearly shows that a rotor cannot be treated independently but must be dealt with as a part of a system.

In practice to-day, the final proportions of a turbine rotor are based on a complete analysis of the rotating system consisting of the turbine rotor, the coupling and the pinion. The procedure takes account of the effects of : the mass and elastic characteristics of each piece ; friction in the hinged connections at the ends of the coupling ; elasticity and damping in the bearings and oil films ; and mass, elasticity and damping of an equivalent supporting structure.

Buckets (Blading).—The configuration of the buckets is similar to the conventional impulse designs, but has been modified to increase strength and aerodynamic efficiency. All buckets are machined from bar stock. The materials used for different temperature ranges are shown in Table III. Generally,

TABLE III—*Bucket Materials for Marine Turbines*

Material	12 CR	Modified 12 CR
Temperature range, deg. Fah.	Up to 900	750–1,000
G.E. specification	B50AM265A	B50AM217B*
Composition :		
Carbon	0·06–0·13	0·13–0·18
Manganese	0·25–0·80	0·40–0·60
Silicon, maximum	0·50	0·50
Phosphorus, maximum	0·030	0·040
Sulphur, maximum	0·030	0·030
Chromium	11·50–13·50	11·50–13·00
Nickel, maximum	0·50	0·50
Tin, maximum	0·05	—
Aluminium, maximum	0·05	—
Columbium	—	0·35–0·45
Physical properties :		
Tensile strength, lb per sq. in (minimum)	100,000	100,000
Yield strength, 0·02 per cent offset, lb per sq. in (minimum)	70,000	70,000
Elongation in 2in per cent (minimum)	20	20
Reduction of area, per cent (minimum)	60	60
Rockwell "C" hardness (maximum)	24	25
Impact, V-notch Charpy, ft lb (minimum)	50	25†

* This material has higher rupture strength at temperatures above 750 deg. Fah.

† Keyhole Charpy.

buckets are attached to the wheel with multiple-hook circumferential dovetails with the base of the bucket fitted over the wheel rim. Segmental covers (shroud bands) are fitted over tenons on the ends of the buckets and secured by riveting.

The design of buckets is made particularly complex by variable-speed operation ranging from full speed ahead to full speed astern. The forces exerted by the steam on each bucket as it passes by the nozzles are non-uniform, due primarily to the wakes behind the nozzle edges. When the frequency of passing of nozzles coincides with the natural frequency of the buckets, the buckets will vibrate in resonance with a great amplification of the stresses. Since the stimulus from the nozzles is non-sinusoidal in character, the magnitude of the stimulus at the higher frequencies corresponding to the second and third harmonics may also be large and the effects must be allowed for.

Observations and measurements show that the buckets in each wheel will be in resonance with some mode of vibration at one or more rotor speeds. The buckets on some wheels will have a great number of resonance points, and some of these may be in complex modes of vibration. Certain of these modes are easily stimulated to amplitudes of vibration which produce high vibratory stresses many times those corresponding to the average driving force.

Buckets operating in steam just below the saturation line in the region of first condensation are weakened by the corrosive action of the newly formed water[1] and this must also be allowed for.

Methods are now available for calculating the vibration frequencies and stresses of banded groups of turbine buckets.[4] With the aid of electronic digital computers, it is practical to apply these methods to normal design work. When supported by tests to measure the vibratory characteristics of buckets on a great number of assembled wheels, representative of the full range of application, the modes and frequencies of vibration can be quite precisely predicted for any particular design.

With the vibratory characteristics predictable, the bucket design can be selected or adjusted in the best way to meet all the operating conditions for a particular application and keep the vibratory stresses within the capacity of the materials. In working out a stage design, the following characteristics can be used in arriving at a suitable bucket design :

(*a*) Modes with high amplification factors can be tolerated when placed in the low-speed range where the stimulus is low.

(*b*) Modes with low amplification factors can be tolerated in the high-speed range.

(*c*) The stimulus from the nozzles can be reduced by modifications in the design details of the nozzles and buckets with some minor sacrifice in stage efficiency.

(*d*) The grouping of the buckets under the shroud bands will alter the modes and frequencies of vibration.

(*e*) Materials with high internal damping may be used ; 13 per cent chromium iron has high internal damping relative to other available materials.

(*f*) Dovetail designs may provide more or less structural damping. For instance, observations indicate that the multiple-hook circumferential dovetail has high structural damping in comparison with other types.

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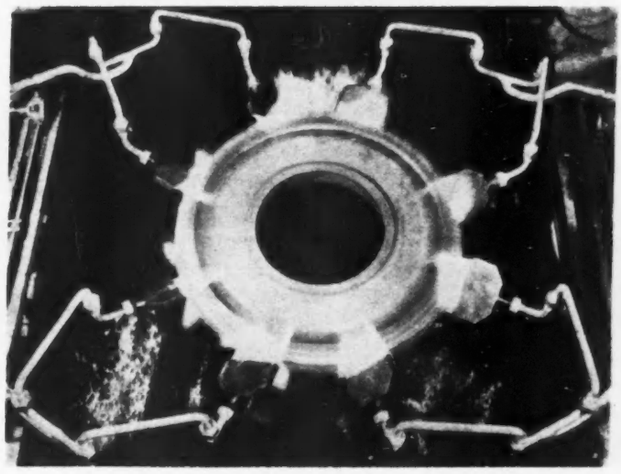
Flame Hardening With Oxy-Town Gas

Town gas, enriched with oxygen, has proved a satisfactory fuel, with easy control characteristics, for hardening the components of excavators which are subject to heavy wear, and is used in machines with numerous automatic features.



MANY of the important working parts of the large excavators made by Ruston-Bucyrus, Ltd., of Lincoln, are subjected to considerable wear by abrasion. It is essential, therefore, that such parts should have hard wearing surfaces, and this hardening must be achieved while leaving the core in its original condition. The company has therefore, for some time, studied the application of flame-hardening and has installed a number of machines in which town gas, enriched with oxygen, is used for treating the surfaces of components at the high temperature required.

A demonstration of this equipment and of other methods used at the works in the production of excavators was given last week. The capacity is approximately 1400 excavators a year, and the fact that the company must count on exporting at least 50 per cent of its output necessitates the closest attention to machinery and techniques because of the highly competitive nature of the business. In the past ten years approximately £3,750,000 have been spent on buildings, plant, machinery and equipment.

The flame-hardening machines inspected during the visit to the works were manufactured by Firma Paul Ferd. Peddinghaus, of Gevelsberg, West Germany, and supplied by Surfard, Ltd., Abford House, 15, Wilton Road, London, S.W.1, the distributor for the equipment in this country. The most recently installed is an equipment for hardening excavator track links which is believed to be the largest flame-hardening machine yet built (Fig. 1). Wearing parts on the links are the four holes which bear on the track pin, two heavy lugs which take up the drive from the sprocket, and the roller path which runs on the trailer wheels. The machine designed for hardening these components comprises a heavy conveyor having eight stations :

(1) Loading station, on which the link is accurately positioned by means of three adjustable supports.

(2) Idle station, in order to allow space for later operations.

(3) Bore hardening position, where the four holes or bearings are simultaneously hardened by the progressive method. The four integral burner and quench units are pneumatically moved quickly to the further end of the bores and then retracted at the correct speed to give the required depth of hardening, the burner and quench unit being integral.

(4) Idle station.

(5) At this station, the lugs are hardened by the spot method, in which the part to be hardened is heated to the hardening temperature and quenched by spray quenches. As the track link is moved to the correct position

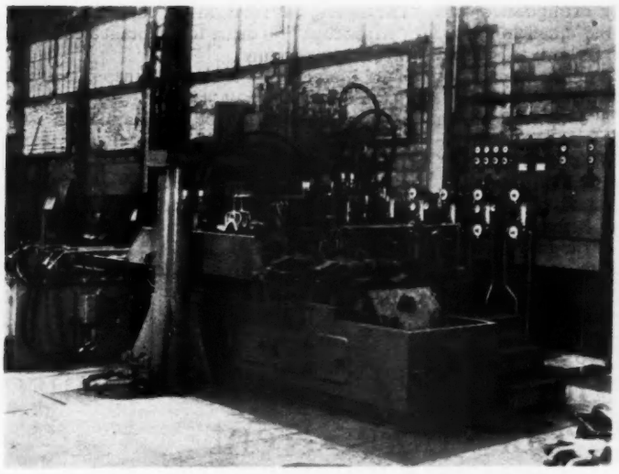


Fig. 1—Machine for hardening bores, lugs and roller path of excavator track links

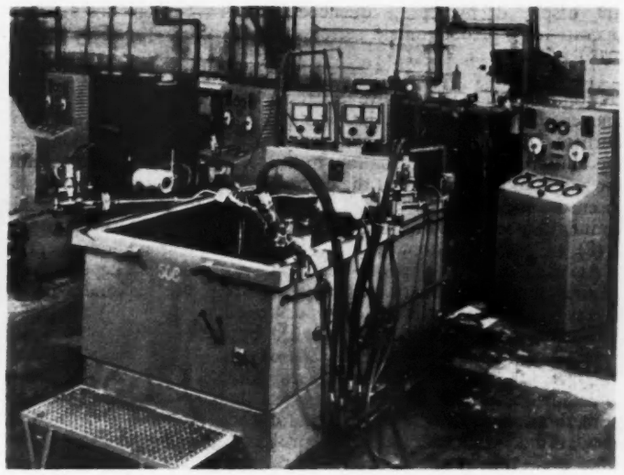


Fig. 2—Equipment for hardening gears of up to 40in diameter by the spinning method

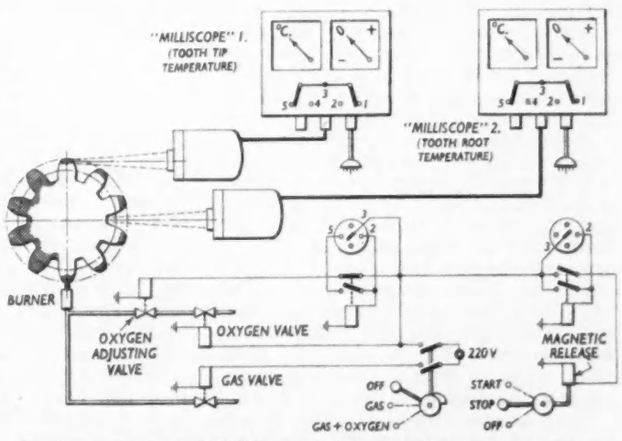


Fig. 3—Arrangement of "Milliscopes" for automatic temperature control in the spinning method of gear hardening

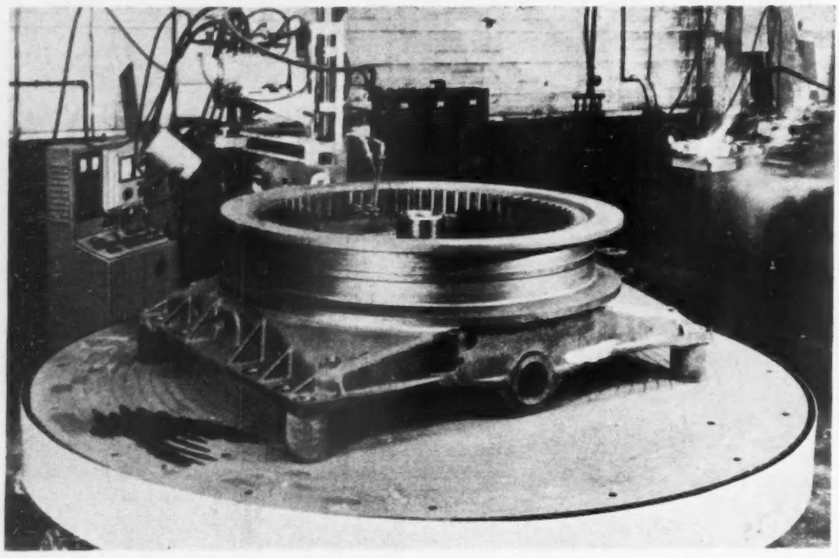


Fig. 4—Internal gear and roller path of excavator truck frame in position on machine for flame-hardening

the conveyor stops and the specially shaped burners (water cooled), which are pneumatically driven, are shifted horizontally to the heating position, where they descend over the lugs and ignite from a pilot flame. On reaching the required temperature, they are displaced by spray quenches which operate for a predetermined period.

(6) Idle station.

(7) The roller path is hardened at this station by the progressive method, the quenches being situated just behind the burners. The link remains stationary, while the burner and quench assembly moves over the length to be hardened at the correct speed to ensure the desired depth. The speed can be infinitely varied by means of a gearbox.

(8) Unloading station.

At each station a photo-electric device ensures that the burners cannot be ignited unless the component is correctly positioned. The various operations are controlled by a preset programme selector. Gas and oxygen supplies for each set of burners are fitted with flow meters and pressure gauges so that a method sheet can be made out for each kind of link to be treated. The approximate total cycle time is six to eight minutes, and each link weighs from 4 cwt to 7 cwt. Town gas, enriched with oxygen in the proportion of 60 cubic feet of oxygen to every 100 cubic feet of town gas, is used for the process, which is carried out at temperatures of 820 deg. to 850 deg. Cent.

Another recent addition to the equipment at the Ruston-Bucyrus works is the first machine in this country to flame-harden large gears by the spinning method (Fig. 2 and title illustration). The maximum capacity of this model is a gear diameter of 40in and a tooth width of 4in. The machine comprises a tank in which the quenching oil is contained, at the centre of which a rotatable spindle is situated, and on this the gear is supported horizontally by means of an adaptor. A number of oxy-town gas burners are arranged around the circumference of the gear. Two "Milliscope" automatic temperature controls (Fig. 3) are provided, one set tangentially to measure the temperature of the tip of the tooth, whilst the other is set radially to pick up the temperature at the root of the tooth.

The gear is rotated at 45 r.p.m. between the burners by means of the spindle and when the tips of the teeth reach the hardening temperature, the oxygen is automatically reduced by a pulsating relay from the first " Milliscope " so as to prevent overheating, thus allowing the remaining part of the tooth to reach the preset hardening temperature. When this figure is obtained, the burners are automatically extinguished and the gear lowered into the quenching oil. A flow of compressed air is directed across the surface of the quenching medium so as to eliminate the possibility of igniting the oil. A built-in cooling device, coupled with an electric thermometer, maintains the oil at the required temperature. This thermometer, by means of a two-way switch, shows the heat of the quenching oil and of the water flowing through the heat exchanger of the cooling equipment, so that the flow of water may be kept to the minimum consistent with the maximum desirable temperature of the oil. A flow meter and pressure gauge unit for gas and oxygen is employed so that, together with the " Milliscope " settings, a method card may be prepared for each type of gear treated.

The heating time to harden a spur gear 39in in diameter, having 124 teeth of 4D.P. and a width of 4in, is approximately twenty minutes if hardening down to the root is required. The gas consumption is about 425 cubic feet and the oxygen consumption 245 cubic feet. At 1s. per therm the cost of gas would be 2s. 2d. and oxygen at, say, 40s. per 1000 cubic feet would be 10s. This process has proved very satisfactory elsewhere and a spin-hardening machine for gears up to 4ft 11in in diameter and with a maximum tooth width of 11·8in is being built at the moment. This machine, the largest of its kind, also makes possible the spin-hardening of crane sheaves to the extra depth necessary to prevent pitting of the components.

A further automatic oxy-town gas flame-hardening equipment is the Type LSW machine (Fig. 4), specially designed to harden the internal gear and roller path of truck frames on which the cabin and the excavating equipment rotate. The teeth of the gear are hardened by the progressive method, the burners to which the water spray quenches are attached rising over the length of the tooth. Both flanks of each tooth are hardened simultaneously. The roller path is automatically hardened by the progressive method, the burners and quenches remaining stationary, whilst the component rotates. The speed of rotation is controlled by a " Milliscope " in order to maintain a constant preset temperature.

At the end of the visit an inspection was made of a Schichau flame-cutting machine, capable of simultaneous operation on two 30ft by 10ft plates from $\frac{3}{16}$in to 6in thick. This is controlled by photo-electric scanning of a negative made from a drawing of the shapes to be cut. The drawing is one-tenth full size and the negative is 1/100th of the size of the original. Drawings are made on special paper with an aluminium base to prevent crinkling or contraction.

Construction of 132kV Switch House at Belvedere, Kent

By I. GLOVER, B.Sc. (Eng.), A.M.I.C.E. and P. P. FOWLER, A.M.I.C.E., A.M.Inst. Struct.E.

The purpose of this article is to describe, primarily from the civil engineering aspect, the construction of a large 132kV switch building recently commissioned at Belvedere in Kent with special reference to some of the methods and materials which were adopted for the construction of the building. The building is 579ft long by 82ft wide and rises 56ft above ground level. The roof covers an area of just over one acre and the whole switch house took approximately eighteen months to complete.

THE Belvedere switchboard is designed to connect the output from the four 60MW and two 120MW generators to be installed at the nearby Belvedere generating station to the 132kV Grid. The ultimate arrangement of the 132kV indoor substation provides for thirty-one switches, including three section switches and four bus couplers, arranged in a " back to back " layout with main and reserve busbars divided into four sections.

Belvedere is situated by the River Thames in a flat, low-lying marshy area. A few years ago the substation site was flooded to a depth of several feet and, although river protection works have since been carried out, it was decided to afford flood protection to the switch house corresponding to that provided at the new Belvedere generating station. This meant mounting the switchgear at a level of 7·5ft above ordnance datum and providing for the total exclusion of flood water up to a level of 12ft above ordnance datum. Mean ground level was at approximately 1ft above ordnance datum.

Belvedere is also an industrial area subject to considerable air pollution from nearby factories and cement works, &c., and in this respect an enclosed substation was clearly operationally beneficial. This factor, coupled with the need to raise the switchgear as a protection against flooding, resulted in a

decision to adopt an " indoor " arrangement in preference to the standard outdoor arrangement.

Site and Subsoil.—Test borings revealed up to more than 30ft a soft alluvium consisting of clay, peat and sand, overlying Thames Flood Plain gravel. Below this were found Blackheath Pebble Beds which, in turn, were resting on stiff clays and sands of the Woolwich and Reading Beds. The geological nature of the subsoil was such that the strata tended to vary considerably in thickness and composition. The natural water table was found to vary from ground level to about 6ft below ground level during the winter months when measurements were made.

Foundations.—Soil mechanics investigations had indicated that piling would be necessary through the soft alluvium and that support could be obtained on the underlying flood plain gravel. When driving actually commenced, however, it was found that the piling sets obtained in the gravel were unsatisfactory and it was decided to punch through the gravel and take a bearing in the stiff clay of the Woolwich and Reading Beds. The depth of piling varied between about 30ft and about 70ft.

Individual piles, with some exceptions, were designed to carry a working load of 45 tons and were used in groups of up to six in number for some of the heavier loads, such as carrying main columns. When tested, the piles satisfactorily supported the required test load of 1½ times the working load with settlements of the order of ¼in.

Tests on ground water showed it to be highly aggressive to ordinary Portland cement concrete and consequently sulphate-resisting cement was used for all the concrete in contact with the ground.

Design of Building and Choice of Materials

Alternative shapes such as parabolic arch forms, were briefly considered for the cross section of the building with the object of obtaining the maximum structural economy. It was concluded, however, that the electrical arrangement conformed most naturally to a rectangular cross section and since supports were in any case required for the central isolators and their associated access walkway, it was finally decided to adopt a rectangular shape with main internal columns as shown

The building was considered to be an industrial building and it was important that it should be built with the minimum cost consistent with functional efficiency and a reasonably pleasing appearance. It was desired to avoid as far as possible the appearance of a factory shed and to provide reasonable but not extravagant standards of thermal insulation, window space and finishings.

Among other considerations which had to be borne in mind were the means of achieving weather tightness with the materials which it was proposed to use and the need to make the building dustproof. At the same time it was necessary to maintain a reasonable standard of ventilation and if possible to avoid excessive humidity within the building.

Some of these requirements were mutually contradictory but it was thought that, the large hall-like compartments within the building being virtually unoccupied, frequent changes of air would be unnecessary and, therefore, it was decided that all openings in the building would be kept permanently shut except when needed for access. Louvred ventilators were provided, covered with fine wire gauze filters to exclude all but very small dust particles, and slow natural ventilation has been relied upon, although provision has been made for the future inclusion of forced ventilation should it be found necessary. Wall linings of a slightly absorbent texture were used and would, it was thought, reduce the effect of any moisture which might collect due to condensation in conditions of high humidity.

It was considered that the objective of minimum cost would best be realised by taking every advantage of simplicity of design, of lightness of weight and of making the utmost use of mass produced materials and the repetition of standardised components. It was envisaged that prefabrication would be used as far as possible but where *in situ* work was necessary designs would be as repetitive as possible in order to make shuttering and bar bending most economic. The design of the building also had the further object of facilitating and encouraging the fullest use of up-to-date mechanised methods of building.

Some of these objectives have been difficult to accomplish or have been vitiated by the inherent complexities of the plant which had to be accommodated but, considering the difficulties arising from the need for flood protection, the poor subsoil and other things, the design has, on the whole, proved to be satisfactory from the point of view of financial economy.

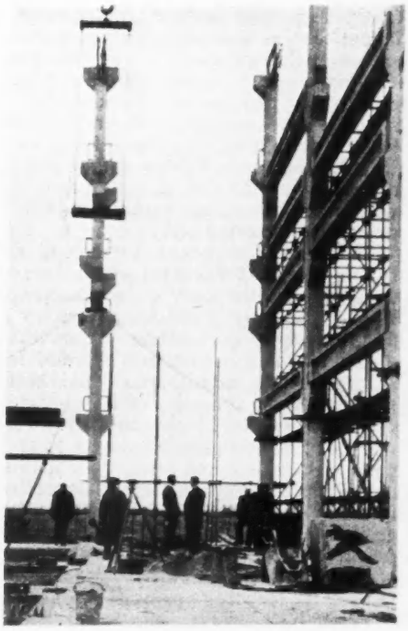
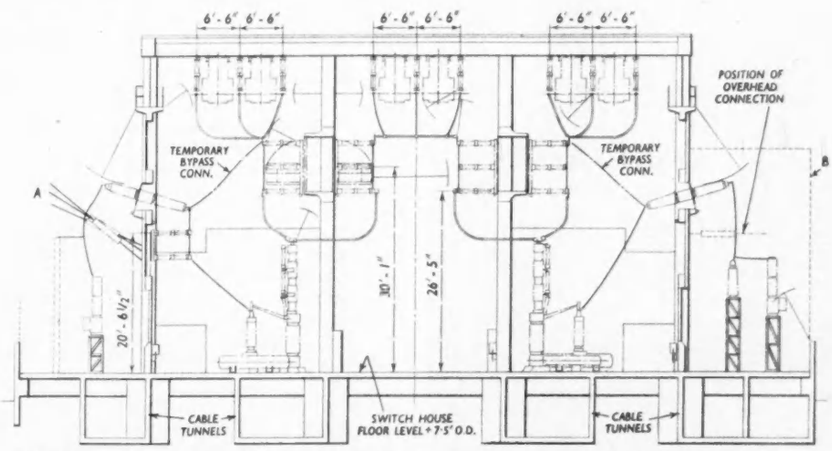


Fig. 2—One of the precast concrete columns is being lowered into a prepared pocket in the foundations. The framework is built up of precast elements as can be seen on the right

After detailed consideration of many kinds of walling materials, the final choice for the wall cladding was a composite construction consisting of 20-gauge aluminium industrial corrugated sheet externally and ¼in thick asbestos board lining internally with 1in thick rock wool sandwiched between. This cladding has a " U " value of 0·2 and is fixed to reinforced concrete horizontal sheeting rails by means of aluminium hook bolts. The colour scheme recommended by the architectural consultant included three main colours, namely, black, silver and dull green. The black and silver were obtained by an anodising process and a process known as " pyluminising " was used for the dull green shade. Weather tightness of the walls was ensured by the use of high-purity aluminium flashings fastened to the sheeting and tucked into preformed grooves in the columns. The flashings were then sealed with a mastic compound.

Several roofing systems were similarly investigated, the roof finally selected being a flat one consisting of a composite construction formed of 20-gauge aluminium industrial corrugated sheet spanning across precast concrete beams to which it was secured by hook bolts. The aluminium sheet was then covered with ½in thick cane fibre insulating board and finally an outer covering of three layers of bituminous felt was applied. The roofing felt was bonded together with hot liquid bitumen and surfaced with a light reflecting dressing of stone chippings. Before fixing, the insulating board was treated with a chemical process to produce a fire-retarding surface. The " U " value of the composite construction was about 0·33.

The switch house floor and the cable basement were constructed in waterproof reinforced concrete, the former being mainly precast and the latter being cast *in situ*. Floor slabs of a minimum number of standard types were precast on site and provided with lifting points, casting one slab on top of another to save shuttering. The slabs, after they had gained sufficient strength, were then lifted into position by crane and bedded on



A.—Downdropper insulation sets will be fitted with extension links as required; for droppers adjacent to the bus section bays the links will be long enough to maintain adequate earth clearance to column.

B.—Internal face of possible future generator annexe enclosure. On generator 2 and 4 bays, the position of sealing end and C.V.T. will be interchanged.

Fig. 1—Cross section of feeder and transformer bays of 132kV switch house at Belvedere, Kent

to the supporting beams by means of prefabricated strips of cold bitumastic compound let into preformed grooves in the concrete. The purpose of these was twofold—first, to ensure water tightness in the event of future flooding, and, secondly, to ensure complete bedding down of all four edges of each slab. The floor was then finished with a cement and sand screed, divided into panels by wooden strips to prevent cracking, and finally treated with an anti-dusting paint.

Access roads were provided around the switch house, and due to the weak nature of the subsoil and the heavy loads to be carried it was considered preferable to employ a flexible type of construction. A carefully graded granular material was specified for this purpose, the material actually used being gravel pit waste consisting of a well-graded gravel with about 10 per cent clay. This was rolled and compacted in layers on to a prepared subgrade and surfaced by a two-coat bitumen macadam, of a total compacted thickness of 3in to B.S.S. 1621 : 1954. The California bearing ratio values indicated a required minimum thickness of 18in, but, in fact, more than this was provided in order to bring the road up to required level.

An 8ft high security fence was provided around the site using stainless steel chain link secured to reinforced concrete posts topped by three strands of galvanised barbed wire.

Access

Owing to the flood hazard, access to the main building has been kept to a minimum and, as far as possible, kept above the assumed highest water level. Certain essential plant access openings below this level have been provided with dam boards which will be kept permanently in position except when plant is being installed.

Access to the high-level isolators and to the windows is provided by steel staircases leading to walkways suspended between the main columns. Access to the roof is obtained by steel ladder from one of the walkways.

For maintenance, the isolators can be reached by folding bascules which can be let down as required and access to the main busbars is given by mobile trolleys running on steel tracks suspended from the roof beams.

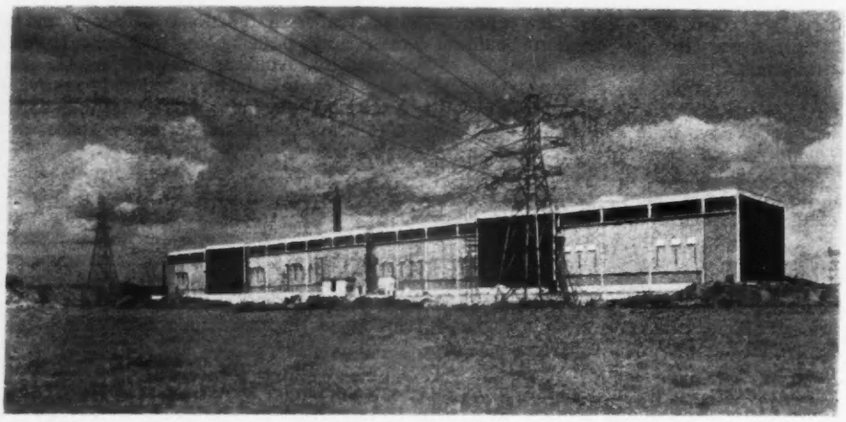


Fig. 4—The finished building of the 132kV switch house at Belvedere

Due to the restriction imposed by the necessity of maintaining electrical clearances and due also, incidentally, to the cost of glazing compared with wall cladding, window space has been kept as small as possible consistent with a reasonable degree of daylighting and has been placed at a high level so as to derive most advantage from the available daylight. Where possible internal surfaces of a light colour have been used to give as much reflected light as possible.

Opening windows have been restricted in number to the minimum necessary for access for cleaning and maintenance. Apart from occasional opening for cleaning, the glazing will remain permanently closed and sealed against the weather.

Structural Design

The primary factor considered in deciding which structural material to adopt was cost, including both capital and maintenance costs. The need for frequent maintenance is not merely a disadvantage in itself, but could be extremely costly in affecting the efficiency of the switch house by requiring otherwise unnecessary outages.

Several possible structural materials were considered, and design and cost analyses were carried out. Of these, when the estimated subsequent maintenance costs were added to the initial cost, it was found that reinforced concrete would probably be the most economical and this material was accordingly adopted.

Among its disadvantages were its heavy weight, the difficulties involved in attaching fixtures of various kinds, such as operating boxes, &c., the difficulties entailed in joining precast elements to form an integral frame and the difficulty of obtaining a good finish which would not be too costly. With regard to the finish it was borne in mind that the building was basically an industrial one and, therefore, it was felt that undue refinement of finish was not appropriate and the appearance of plain untreated concrete, provided it had a reasonable finish, was, in this context, acceptable.

It was thought that, due to the considerable height of the building without intervening floors, precast concrete would be cheaper and of better quality than *in situ* concrete, and it was consequently decided to base the design upon the adoption of the precasting technique for all structural members above switch house floor level. The invitation to tender was, however, framed in such a way as to give the contractor the opportunity to state a preference for alternative methods of construction if he could offer a lower price by so doing. The lowest tenderer did, in fact, accept the design as it stood.

The main frame was devised to take full advantage of structural continuity and complete rigidity was assumed in the design and provided by careful detailing in practice. By this means the columns, which were the major members, were kept sufficiently slender and light in weight to enable them to be lifted by crane and lowered into prepared pockets in the foundations, the pockets being afterwards concreted in. Fig. 2 shows a column in the process of being erected. Special joints were designed at the junction of one member with another, using *in situ* concrete, to enable the precast elements to be firmly fixed to each other and, at the same time, develop the full bending moment existing at that position. A heavy-duty travelling crane, mounted on rails, was used to erect the framework and this was moved along as the work progressed. A view of this procedure in progress is shown in Fig. 3.

Since the columns and certain other concrete members were to be exposed to view as an architectural feature, it was of major importance that the concrete should be of a quality which would resist weather erosion, particularly the disruptive effect of severe frost. Furthermore, it was essential that none of the precast elements should have

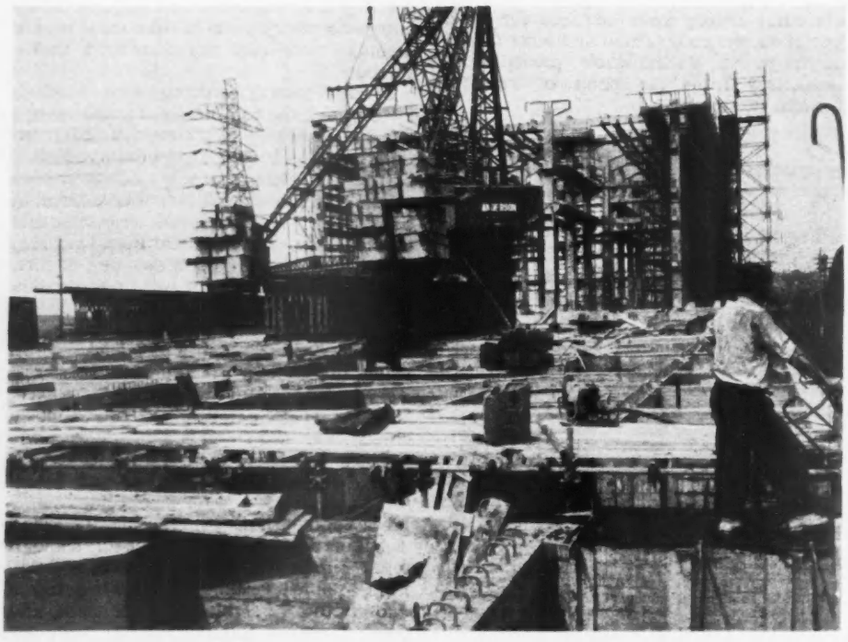


Fig. 3—Travelling crane in use during erection of framework of 132kV switch house at Belvedere

a weight in excess of 10 tons, since anything heavier would have been impracticable to lift by the means available. For these reasons it was decided that, in addition to adopting the fully continuous structural design mentioned above, the highest practicable working stresses would be used in the design.

It can be said that most of the desirable properties of concrete—for instance, frost resistance—can be related to its compressive strength—that is, the higher the strength the better are these qualities. Accordingly, concrete with a minimum crushing strength of 5000 lb per square inch at an age of twenty-eight days, using ordinary Portland cement, was specified and cold worked steel, conforming to B.S.S. 1144, was used throughout for concrete reinforcement in precast elements. Where *in situ* concrete was used, mainly below switch house floor level, ordinary mild steel to B.S. 785 was adopted.

The building was designed to resist wind forces as specified in Chapter V of British Standard Code of Practice C.P.3 : 1952, and the design conformed to the requirements of B.S. Code of Practice C.P. 114 (1948).

COMPACTING FACTOR	CUBE No.	DATE TESTED	DOT DIAGRAM OF CUBE STRENGTHS 7 DAY 3,000 4,000 5,000 6,000 7,000	CRUSHING STRESS x LB./SQ. IN.	AVERAGE $\bar{x}$	$(x-\bar{x})$	$(x-\bar{x})^2$
	1J. 67	15-3-57		5060		94	8,836
0·748	2J. 67	"		5040		74	5,476
	3J. 67	"		5100		134	17,956
	1J. 68	16-3-57		4310		656	430,336
0·739	2J. 68	"		4700		266	70,756
	3J. 68	"		4560		406	164,836
	1J. 71	19-3-57		4040		926	857,476
0·755	2J. 71	"		4040		926	857,476
	3J. 71	"		4010		956	913,936
	1J. 72	20-3-57		4960		6	36
0·732	2J. 72	"		4850		116	13,456
	3J. 72	"		4720		246	60,516
	1J. 74	22-3-57		4600		366	133,956
0·730	2J. 74	"		4600		366	133,956
	3J. 74	"		4540		426	181,476
	1J. 75	23-3-57		4410		556	309,136
	2J. 75	"		4850		116	13,456
	3J. 75	"		4790		176	30,976
	1J. 77	25-3-57		6040		1070	1,144,900
0·707	2J. 77	"		5960		994	988,036
	3J. 77	"		5780		814	662,596
	1J. 79	27-3-57		6120		1154	1,331,716
0·750	2J. 79	"		6220		1254	1,572,516
	3J. 79	"		6220		1254	1,572,516
	1J. 81	29-3-57		5600		634	401,956
0·724	2J. 81	"		5960		994	988,036
	3J. 81	"		5960		994	988,036
	1J. 82	30-3-57		4230		736	541,696
0·765	2J. 82	"		4410		556	309,136
	3J. 82	"		4290		676	456,976
	1J. 85	2-4-57		5250		314	98,596
0·712	2J. 85	"		5190	4,966	224	50,176
	3J. 85	"		5540		574	329,476
	1J. 88	3-4-57		5040		74	5,476
0·695	2J. 88	"		5060		94	8,836
	3J. 88	"		4940		26	676
	1J. 86	5-4-57		5320		854	729,316
0·774	2J. 86	"		5860		894	799,236
	3J. 86	"		5840		874	736,876
	1J. 89	6-4-57		4960		6	36
0·690	2J. 89	"		4660		306	93,636
	3J. 89	"		4860		106	11,236
	1J. 92	9-4-57		4540		426	181,476
0·714	2J. 92	"		4540		426	181,476
	3J. 92	"		4380		586	343,396
	1J. 94	11-4-57		4910		56	3,136
0·672	2J. 94	"		5410		444	197,136
	3J. 94	"		4790		176	30,976
	1J. 95	12-4-57		4660		306	93,636
0·725	2J. 95	"		4880		86	7,396
	3J. 95	"		4660		306	93,636
	1J. 98	15-4-57		4390		576	331,776
0·780	2J. 98	"		4290		676	456,976
	3J. 98	"		4140		826	682,276
	1J. 99	16-4-57		5660		694	481,636
0·780	2J. 99	"		5160		194	37,636
	3J. 99	"		5400		434	188,356
	1J. 101	18-4-57		4350		616	379,456
0·747	2J. 101	"		4350		616	379,456
	3J. 101	"		4350		616	379,456
	1J. 102	19-4-57		4600		366	133,956
0·747	2J. 102	"		4600		366	133,956
	3J. 102	"		4600		366	133,956
	1J. 106	23-4-57		5640		674	454,276
0·730	2J. 106	"		5590		1094	1,196,836
	3J. 106	"		5380		414	171,396
				327,760			24,699,400

STANDARD DEVIATION

$$S=\sqrt{\frac{\Sigma(X-\bar{X})^2}{n-1}}$$ LB./SQ. IN.

$$S=\sqrt{\frac{24,699,400}{65}}=\sqrt{379,991}=616\ \text{LB./IN.}^2$$

COEFFICIENT OF VARIATION

$$V=\frac{S}{\bar{X}}\times 100 \qquad V=\frac{616}{4966}\times 100=12{\cdot}4\%$$ PER CENT

66 RESULTS

$$\frac{327,760}{66}=4966$$

Fig. 5—Quality control chart for seven day strengths using concrete

The working stresses used were 1400 lb per square inch in compression for the concrete and 27,000 lb per square inch in tension for the cold worked steel. A modular ratio of 12 was assumed. The permissible working stresses for concrete and steel were increased to 1800 lb per square inch and 32,000 lb per square inch respectively for the purpose of resisting stresses due to wind only. Where mild steel was used the tensile working stress was not allowed to exceed 18,000 lb per square inch normally and 16,800 lb per square inch for reinforced concrete which might be required to retain water.

To attain the high standard of concrete quality which was required for this work a method of quality control was established at the outset of the job and a high standard of site control set up.

The concrete specification was specially framed to allow the contractor to vary the proportions of materials as he wished subject to the approval of the engineer, in order to achieve the desired strength, and subject to the proviso that the quantity of cement should be a minimum. By this means it was thought that the contractor would be encouraged to produce the concrete most economically and the proviso regarding cement was inserted not primarily with the object of economy, but to avoid the achievement of strength by the mere use of excessive quantities of cement with resulting unsatisfactory concrete.

The object of the quality control procedure was first to achieve a consistency of strength and workability by reducing the variation in test results to the smallest possible range and to ensure that, after taking account of the variation, none of the test results would fall below the specified minimum values. It was found that only a negligible and acceptable proportion of random results actually fell below the required minimum and the degree of control exercised resulted in a satisfactory limitation of the amount of variation.

Site control of the concrete quality was based on the 28-day crushing strength. In practice, however, the 7-day results were actually used, in conjunction with the results of the compacting-factor test, to provide data upon which earlier action could be taken than would have been possible using the 28-day strength alone.

Fig. 5 shows a typical control sheet on which concrete strengths were recorded in the form of a dot diagram. This gave a visual indication of any relaxation in control by the extent of the scatter which would develop as a consequence. Similar diagrams were used for the compacting-factor test and as far as possible forms were devised for all routine tests such as aggregate grading and moisture content; these were carried out at regular intervals throughout the course of the job.

The standard deviation for the results shown on Fig. 5 is 616 lb per square inch and the coefficient of variation is 12·4 per cent. The number of results on Fig. 5 is sixty-six and, as can be seen, they are spread fairly uniformly over a period of about six weeks. These values were fairly typical of the concrete test results as a whole. A small site laboratory was equipped to deal with mix design and the day-to-day testing of concreting materials.

The concrete was transported from the mixer to the work by self-propelled monorail trucks and was thoroughly compacted into the forms by the use of needle vibrators.

Fixings to the concrete for various items of equipment were provided for by casting into the concrete galvanised metal threaded

inserts. This meant a considerable amount of pre-planning and early consultations between the civil and electrical contractors. The latter provided accurately machined templates for important groups of bolt fixings but for many of the fixings, such as for earth strips, it was only necessary for the civil contractor to make drillings in the concrete shuttering to receive the inserts. For some of the minor fixings for such things as lighting runs a cartridge gun was used but, by and large, drilling after the concrete was cast was discouraged. Fig. 4 shows a view of the finished building.

Costs

The cost of the switch house can conveniently be split into two parts: work above the switch house floor and work below it. The work below the switch house floor level comprises piling and foundations, cable basement and flood protection, &c., all of which is only applicable to this particular site. The work above the switch house floor, however, comprising structure, cladding, roof, walkways, &c., could be common to a similar building if used on another site.

The cost of these two parts, based on the amount of the accepted tender, has been assessed at approximately £5000 per switch for each part, making £10,000 per switch total cost. It is expected that by the time the final actual cost is known the amount will be of the order of £10,500 per switch. This shows a saving of the order of 40 per cent on previous designs of a more traditional form of construction. It will be seen that a large proportion of the cost has been absorbed by foundations and special works, such as flood protection, peculiar to this site.

Acknowledgments

The switch house was engineered under the direction of the Chief Transmission engineer, C.E.G.B. Headquarters, by whose permission this article was written, and the site supervision was carried out under the direction of the transmission engineer, C.E.G.B. London Division. The main contractor for the civil engineering work was J. Jarvis and Sons, Ltd., and for the electrical engineering work the English Electric Company, Ltd. The architectural treatment of the building elevations was advised by Messrs. Farmer and Dark.

Multiple Presentation Marine Radar

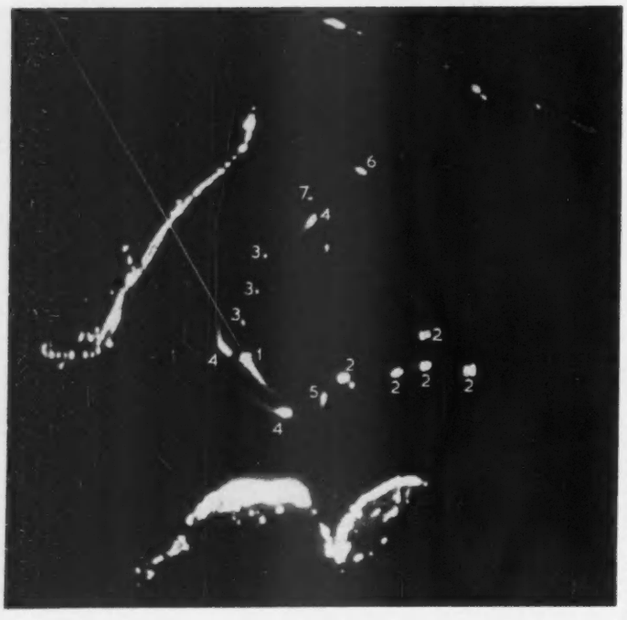
RECENTLY on board the motor yacht "Rinansey," the British Thomson-Houston Company, Ltd., demonstrated its new "Escort" radar which has been developed to provide quick and correct assessment of any situation so that action can be expedited. With earlier equipment, measurement, calculations and plotting were necessary to interpret the picture so that a time lag was inevitable. To overcome this disadvantage and to enable the equipment to interpret rather than merely record, the company has introduced this new radar in which four forms of P.P.I. display can be selected to meet the requirements of different situations. These forms are: "Chart Plan" presentation, "Vantage Point" off centring and resetting, "Auto-Trim" picture alignment, and electronic bearing marker.

With the control set for "Chart Plan" presentation the centre of the rotating sweep, which is the ship itself, moves across the picture along the line of the heading marker at a speed corresponding to ship's own speed. This gives the display a fixed frame of reference with fixed objects appearing as stationary echoes while moving objects have echoes with tails which indicate true course. However, relative data is of value, with closest approach distance being an example, and by means of a selector switch the "Chart Plan" shift generators can be halted so that the tails of the echoes will turn and indicate their relative courses. Other positions of the selector switch provide for either "north upwards" or "ship's head upwards." Scale of display affects the degree of accuracy, which is within a few per cent; however, to realise this accuracy tides must be set in on the control provided.

To maintain the "Chart Plan" display for the maximum period, the ship's own position must be reset to an off-centre position such that the heading marker passes through the geometric centre of the display. The "vantage-point" off-centring system moves the starting point to a distance of two-thirds of the radius from the geometric centre and allows for movement through the centre and for one-third of the radius beyond. The interval between resetting will depend upon speed of ship and the range scale selected. The automatic reset circuit can be delayed if resetting might interfere with an observation. This "vantage point" system operates quickly and the electronic reset is completed before the aerial has rotated 2 deg.

The "auto-trim" picture alignment provides for the heading marker being automatically correctly orientated, regardless of changes of course since the equipment was last used. The system is self-monitoring. To enable bearings of echoes to be determined when the display is off-centred an electronic bearing marker is provided which can be orientated without waiting for it to point and can be read from the same cursor around the circumference of the display. For combating malfunctioning of the set there are five small panels which light up for abnormal conditions and two of these remind the operator that he has switched in one of the special picture analysis aids. A typical display is shown in our illustration.

The "Escort" marine radar—type 601, illustrated herewith, has a 12in diameter tube and operates on the following range scales: ¾, 1½, 3, 6, 12, 24 and 48 nautical miles, to which "chart plan" presentation applies to all except the 24 and 48 mile scale. The variable range marker is available in all ranges and the minimum range is 30 yards, while the range accuracy is ±2 per cent and the bearing accuracy ±½ deg. The transmitter has a peak power output of 45kW, a pulse length of 0·12 and 0·25 microsecond and a pulse repetition rate of 1200 c/s. A slotted wave guide scanner is mounted and has horizontal and vertical beam widths of 1·4 deg. and 24 deg., respectively, the maximum side lobe being −32 dB down on main beam. Sea-clutter suppression, fast-time-constant control and manual gain control form part of the receiver system which has an l.f. of 50 Mc/s, a l.f. bandwidth of 14 Mc/s, and a noise factor of 14 dB. Power consumption of the set is 1·3kW and the maximum permissible mains voltage fluctuation is ±20 per cent.



1—M.Y. "Rinansey," using the deep water channel into Southampton.
2—Shipping moored in Cowes Roads.
3—Channel buoys.
4—Large vessels entering and leaving Southampton.
5—Ferry (not using buoyed channel).
6—Small craft (not using buoyed channel).
7—Calshot Spit light.

The Solent (3-mile range scale)

"Escort" marine radar 12in display unit

Uprated Engines.—Two medium-speed diesel engines in the V.C.B. range manufactured by Ruston and Hornsby, Ltd., have been pressure charged and are known as VCBX engines. They are five- and six-cylinder units having a bore of 8in by a stroke of 10½in, and have been fitted with a single-stage centrifugal blower driven by an exhaust gas turbine and are air-cooled. The 5VCBX engine develops 255 b.h.p. at 600 r.p.m. and 276 b.h.p. at 650 r.p.m. and the powers developed by the 6VCBX engine at the same speeds are respectively 306 b.h.p. and 330 b.h.p. These engines are available for marine propulsion; the 5VCBXM unit is rated to give a maximum continuous service power at the gearbox output coupling of 213/230 b.h.p. at 600/650 r.p.m. while the corresponding rating for the 6VCBXM engine is 256/277 b.h.p. over the same speed range. When used as marine auxiliaries the engines have the mark VCBXZ and develop the same power as the VCBX units.

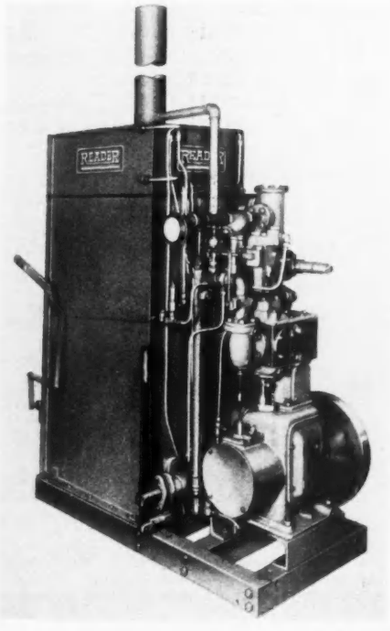
Transportable Steam-Driven Power Set

To provide a simple efficient power set for use in remote areas and undeveloped countries an interesting transportable steam power set has been developed by E. Reader and Sons, Ltd. This set comprises a 5–6 b.h.p. steam engine with a compact steam generator and weighs only 25 cwt. It can be adapted to burn a variety of fuels and is designed for safe and simple operation by completely unskilled labour.

HIGH-SPEED steam engines have been made for many years by E. Reader and Sons, Ltd., Cremorne Street, Nottingham, and on the basis of its wide experience the firm decided a year or so ago to introduce a transportable steam-driven power set suitable for use in remote areas and undeveloped countries. When designing this new equipment it was decided that it would of necessity have to be of simple construction ; safe for operation by unskilled labour ; readily assembled and dismantled for transport ; easy to maintain and service ; and suitable for burning many different kinds of fuel. With these essential points in mind the firm developed and built the simple compact power set shown in the illustrations on this page.

The set is assembled on a frame base member and comprises a steam generator, having a working pressure of 120–150 lb per square inch and a nominal evaporating capacity of 300 lb per hour, with a vertical steam engine developing 5–6 b.h.p. at 450 r.p.m. which is able to attain an intermittent overload of 7–8 b.h.p. The way the main component units can be dismantled and packed in a relatively small compass is shown in the second illustration. The total weight of the complete set is under 25 cwt, and the heaviest part can be carried with ease by two men.

The steam generator can be operated with complete safety by unskilled labour. It does not incorporate any orthodox fire drums or headers, and as only ten pints of water are contained in the evaporator circuit the danger of explosion is virtually eliminated. We are informed by the makers that in experiments to test the degree of safety the water supply to the generator was cut off deliberately whilst the set was under full load. After a period during which the water had been exhausted in the circuit a full flow was then re-introduced without the occurrence of an explosion or causing excessive damage to the tube elements.



Combined steam engine and generator, 5—6 b.h.p. power set assembled ready for operation

The steam generator is of controlled flow monotube design, the evaporator circuit being arranged to flow backwards and forwards in a zig-zag manner across and down a series of horizontal banks of tubes. Water is pumped to a feed tank above the tube element from any available source of supply, such as a river. From the tank the water is pumped directly through a preheater at the bottom of the tube element, delivery being controlled by a low-pressure regulator and a surplus water regulator. From the preheater the water passes up through a tubular de-superheater to the top of the evaporator. Steam leaves the evaporator at a temperature of about 750 deg. Fah. and passes through the de-superheater directly on to the engine via a temperature control regulator.

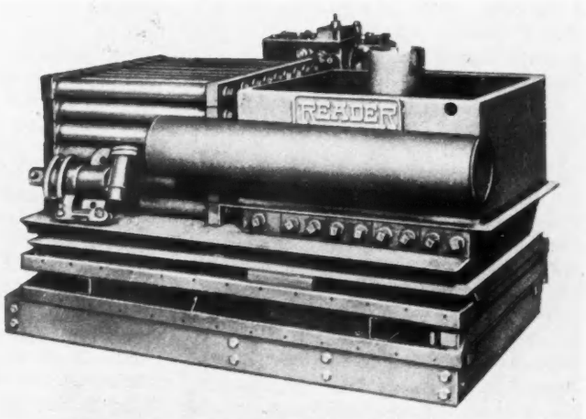
To ensure effective heat transfer and reduce the volume of water required in the circuit to the required minimum, cored element tubes are used in the evaporator section of the steam generator. These elements of chromium molybdenum seamless steel tube have a 1·5in diameter bore and into them are fitted core tubes of 1·25in diameter. Through spigots welded into each end of these core tubes they are supported centrally in the element tubes from plugs screwed into connector blocks fitted between the ends of the tubes. The core tube spigots have a degree of endwise movement in the supporting plugs to compensate for longitudinal expansion. When it is required to inspect, clean, or de-scale the main tube elements the plugs are removed and the cores withdrawn to give free access without need for disturbing the connector blocks or any other parts of the main assembly.

A hand-operated pump fitted at the side of the engine is used to transfer water from the feed tank and fill the evaporator tubes for starting purposes. Immediately sufficient steam is available to run the engine the main automatic feed pump comes into operation.

The firebox at the base of the generator assembly is of steel plate with a refractory lining and it can be arranged to burn most forms of fuel varying from low grade coal, lignite or peat to wood and agricultural wastes. A large soot door is fitted at the front of the firebox to allow external cleaning of the evaporator tubes. The exhaust steam and gases from the firebox leave the set through a chimney above the water tank.

The single-cylinder double-acting steam engine used on the set is totally enclosed and of weatherproof construction. It has a bore of 4in with a stroke of 3in, and its piston valve mechanism is arranged for reversing the direction of rotation if required. A heavy flywheel at one end of the crankshaft incorporates a driving pulley. A totally enclosed governor mounted on the opposite end of the crankshaft actuates a sliding double-beat valve to give a close degree of speed regulation. The lower part of the crankcase provides a large oil reservoir for an effective splash lubrication system, and the consumption of oil is stated to be negligible, a dipstick being fitted for checking oil level when necessary.

One of two automatic pumps fitted above the engine draws water from the source of supply and delivers it to the feed tank. The second pump delivers the water to the steam generator. Once the engine is running it is stated to be impossible for the boiler to be deprived of water unless the suction side of the supply pump is allowed to run dry. The set is particularly designed for use in areas where water supplies have to be drawn from natural sources where fine solids are often in suspension. For this reason strainers are fitted on both suction and delivery sides of the pumps and a settling chamber is provided in the feed tank.



Power set dismantled and packed for transport

All control gear on the engine is mechanically operated, and no thermostatic or diaphragm controls are used. When initial setting of the controls has been completed, it is stated, no further adjustment should be necessary, and safety covers are incorporated on all essential controls to prevent unauthorised tampering.

The set is stated to be of sufficient power to drive a 3kW generator ; a pump of some 10,000 gallons an hour capacity ; or equipment such as a circular saw, threshers, grinding mills, &c. A demonstration set at the maker's works is coupled to a belt-driven generator, and with it a wide range of load conditions can be simulated to show the capabilities of the equipment.

LETTERS AND LITERATURE

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

SCIENCE MUSEUM CHANGES

SIR,—May I, as a former Keeper in charge of an Engineering Department of the Science Museum, comment on the leading article in your issue of February 13 about changes in the Museum? Perhaps I may, in the first place, point out that it is rather less than fair to the Museum to suggest that the opening of the new Iron and Steel Gallery "shows up the urgent need to re-arrange and re-organise not merely other galleries, but the whole of the exhibits in the Museum." Since the war the Museum has modernised its galleries whenever provided with the opportunity and the means, as may be seen, for example, in the galleries devoted to mining, agriculture, town gas manufacture and electrical engineering. The two latter galleries, opened respectively in 1954 and 1957, were developed in collaboration with the Museum by the industries concerned who contributed most of the cost, in one case about £40,000, and in the other more than £70,000. Incidentally, the gas industry inaugurated their scheme before the war and were the first industry to come to the Museum's help with a collective effort of this kind. Both these galleries are in a modern style and will bear comparison with the best recent practice in Scandinavian and Continental museums. It is essentially a modern museum style and not a development of display techniques appropriate to temporary commercial and industrial exhibitions. The more important point, however, is that this style of display reflects the principles on which the exhibits were collected, arranged and labelled. It was the aim of the industries and of the Museum to illustrate historical development, to explain modern practice with really informative labels, while providing sufficient working exhibits to stimulate visitors and retain their interest. The approach, in fact, is essentially a cultural one, and if one believes at all that science and technology have a cultural content surely this must be right for a national museum.

There is a fundamental difference between the cultural approach and, for example, the approach of some American technological museums, in which industries try to outbid each other in "selling" themselves to the public with all the paraphernalia of commercial display techniques. Maybe there is little danger of such extremes here; but as, I think, is implicit in your article there are several lines along which this great national institution of ours might develop during the coming formative years, and where the emphasis is going to be placed is a matter of concern to the public generally and to scientists and engineers in particular.

All this is not to say, of course, that the cultural approach renders the Museum collections of little value in attracting young people into science and technology. There is plenty of evidence to the contrary. The type of person who makes an engineer is apt not to care for propaganda and to distrust elaborate display techniques; but he does want reasonably full information in labels, and so does the technical student and the interested adult visitor. They ought not to be compelled to buy a catalogue or come armed with a textbook.

If you will allow me the privilege of a little more of your valuable space I would like to refer to another aspect of museum policy. Obviously no museum collections can be right up to date on a technical subject, for to show current research is usually impossible, and current practice often difficult except for short periods. To meet this difficulty it was the practice before the war to stage frequent temporary special exhibitions dealing with selected sciences and technologies. For these the Museum had the help of the interested parties concerned, and particular emphasis was laid on current research and practice—which could be done successfully on a short-term basis. These exhibitions were extremely popular with students and other young people, but for various reasons they were dropped after the war and have not been revived except in a different form and on a small scale. Surely the combination of permanent collections with a mainly cultural intention with temporary special exhibitions of the kind I have described, is the right policy and should be pressed upon the Museum authorities. It makes the best of both worlds.

F. ST.A. HARTLEY

Horsham,
Sussex,
March 11, 1959.

STANDARDS MAKING

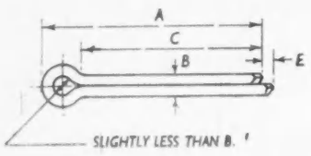
SIR,—In reply to "M.I.Mech.E.'s" letter in your issue of February 20 on the subject of Split Pins (B.S. 1574) recently re-issued, it would appear that the administration on the subject of so-called specifications in the correspondent's establishment is somewhat behind the modern and progressive thinking which the British Standards Institution is trying to inculcate.

The essence of his trouble will be found in the internal administration and in the way Parts Lists are made up. If, instead of specifying split pins by diameter and nominal length, &c., he allocated to each an engineering specification number or standards number, he would find that instead of altering "millions of specifications, bills of materials and such like" he would merely have had to alter one standard sheet. I enclose two Standard sheets showing how the change of specifications of split pins has been effected in this company.

If in addition to split pins he would also standardise all his commonly used parts, he would find himself able to "get done in one hour that which previously took two or three"—or even more. I feel that B.S.I. Standards, far from being barnacles on the keel of productivity, provide the anti-fouling, if used intelligently.

F. POLLACK, A.M.I.Mech.E.,
Chief Engineer.

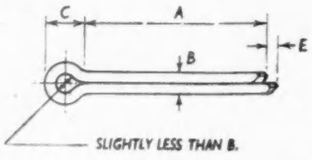
Hamworthy Engineering, Ltd.,
Poole, Dorset,
March 11, 1959.



3	Nominal Size of Bolt or Screw		1/4, 5/16, 3/8	7/16, 1/2	5/8	3/4, 7/8	1	1 1/4	1 1/2
4	Diameter "B"	Nom.	1/16	3/32	1/8	5/32	3/16	7/32	7/32
5		Max.	0·062	0·093	0·124	0·155	0·186	0·217	0·217
6	Nominal Length "A"	Nom.	1	1 1/4	1 1/2	2	2 1/4	2 1/2	3 1/4
7	Effective Length "C"	Approx.	3/8	1 1/16	1 1/4	1 13/16	1 7/8	2 5/16	2 13/16
8	Additional Length of long Leg "E"	Approx.	1/16	1/16	1/8	1/8	1/8	1/8	1/8
9	Item No.		002	005	006	008	009	010	011

How to Specify on Parts List: Give Standard No. followed by Item No. (Line 9) and Material Code (Column 2) thus: ST 3134005/AA.
How to Specify on Order: State Quantity required, Description, Material (Column 1), Nominal diameter (Line 4) by Nominal Length (Line 6).
Example: "2 Gross Split Cotter Pins to B.S. 1574, Mild Steel, 1/16in diameter by 3/8in long."

OLD ISSUE



3	Nominal Size of Bolt or Screw		1/4, 5/16, 3/8	7/16, 1/2	5/8	3/4, 7/8	1	1 1/4	1 1/2
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5		Max.	0·062	0·093	0·124	0·155	0·186	0·217	0·217
6	Nominal Length "A"	Nom.	3/8	1	1 1/4	1 1/2	1 3/4	2 1/4	2 1/2
7	Max. Length of Eye "C"	Approx.	0·16	0·23	0·30	0·36	0·44	0·50	0·50
8	Additional Length of Long Leg "E"	Approx.	1/16	1/16	1/8	1/8	1/8	1/8	1/8
9	Item No.		002	005	006	008	009	010	011

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NEW ISSUE

WHY RESTRICT OUTPUT ?

SIR,—It is, of course, a commonplace by now that the Russians can expand their economy as fast as capital accumulation permits because they have almost complete control over the three vital variables of labour, management and finance. However, it does not follow from this that our relatively free economy must be content with continual restriction of expansion, lest it run into uncontrollable inflation. This may have been true in the past but the advent of modern data processing methods should lead to a fundamental change here.

While our Government does not control labour or management, it does control what, in our system, is the critical variable, monetary policy. Due to the profit motive, the other two become almost dependent variables so that the rate of expansion now bears a fairly linear relationship to the supply of money and credit laid on by the Government. The only trouble is that money injected (or, rather, left) in the economy to-day by an expansion-minded Government will result in raising output only several years later ; meanwhile it has been in the hands of the public long enough to cause inflationary pressure. By the time this is relieved through the increased flow of goods, the Government usually feels compelled to restrict the flow of money, bringing expansion to a standstill. This much we have learned from Keynes.

The problem, of course, is to tailor the supply of money accurately to the supply of goods which, other things being equal, will always tend to expand through increases in productivity. This is where electronic computing comes in, for, if full data about investment, productivity and all other statistics bearing on the problem of inflation were immediately available, monetary control would suffice to keep the economy on a steady course.

If I may draw an analogy from process control : the Russians are using individual control loops for each process variable ; whereas we are trying to use end-product control by regulating only the one critical variable of money supply. This can be done, but not with the enormous process lags of several years. Modern methods of collecting and processing statistics could reduce the lags to a matter of weeks, giving correspondingly finer control.

E. G. SEMLER, B.Sc., A.M.I.Mech.E.,
Editor.

Automation Progress,
Leonard Hill House,
9, Eden Street,
London, N.W.1,
March 10, 1959.

Book Reviews

Concrete Practice.—Vol. 1. By R. H. ELVERY. Contractor's Record, Ltd., Lennox House, Norfolk Street, Strand, London, W.C.2. Price 28s.

THIS book is intended as a textbook for the Grade I Course of the City and Guilds Certificate in Concrete Practice. With the ever-increasing demand for concrete of a higher and more consistent quality, it has been realised that those responsible for the production of concrete on site must be properly trained if full advantage is to be taken of new developments and techniques. The City and Guilds of London Institute, at the suggestion of the Reinforced Concrete Association, has prepared a course of study suitable for supervisors and potential supervisors concerned with concreting operations. In 1955, the Institute began to hold examinations and those who reached a satisfactory standard are awarded a Certificate in Concrete Practice. The course is divided into Grade I and Grade II. The syllabus for each Grade is covered by twenty-four two-hour evening classes, held at technical colleges all over the country. The Grade I course is self-contained and covers, in an elementary way, the general requirements of the charge-hand, foreman and ganger. The Grade II course, which is of benefit to engineers and clerks of works, is more advanced and covers the same field in greater detail.

To ensure a common method of approach, all colleges keep in step and instructors are given the outlines of the lectures in note form. This allows a student, whose work takes him to different parts of the country, to be transferred easily from one college to another. As this book is based on these notes and the chapter headings correspond to the sections of the syllabus, the author has obviously covered the subject. The question is, therefore, whether the subject matter is suitably presented. A textbook of this nature must be extremely particular in its approach because the students attending the course are of an unusual kind. They are essentially practical men who have a wide site experience, but little theoretical knowledge. They have little spare time for study, and the prospect of an examination is possibly rather frightening to some of them. The book, then, must present the required information in a simple and easily assimilated way. This the author has achieved, but something more is required. To the student who buys the book, the examination is all-important. He wants some idea of what form the questions will take, and the text so indexed that he can refer to the correct answers easily and readily. This could be achieved by having questions from previous examination papers at the end of each chapter.

The author, in trying to conform too closely to the lecture notes, which are meant to be a guide only, has omitted some parts of the subject. Questions set in previous examination papers and not covered include expansion joints, and suggested mix proportions for various types of work. Presentation of information by "cataloguing facts" may not make attractive reading, but might be more suitable for this subject. Pictorial methods of explanation could be used more often, e.g. the effect on workability of increasing the sand content of a mix could be better explained by diagrams.

This book will be of interest to the beginner who wishes to obtain a basic knowledge of the practical side of concrete technology, but if at this price it is to be a successful textbook for the City and Guilds students, some revision in future editions is necessary, or the second volume should be combined with the first.

Uranium and Thorium. By L. GRAINGER B.Sc., A.I.M. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 25s.

THE growth of the atomic energy industry has thrown into prominence the technology of metals of which little was known until very recently, and there is a growing need for general surveys of the information available. Mr. Grainger has provided such a survey for uranium and thorium, having particularly in mind the needs of technologists in organisations not at present primarily concerned with atomic energy.

The book covers a very broad front and it is therefore inevitable that any particular topic is treated only briefly, although a mere three and a half pages for the chapter on health hazards seems too meagre. It may be questioned, however, whether the broadness of front is really desirable, and it is doubtful whether many of the readers the author has in mind will pay much attention to the opening two chapters, which deal with the extraction metallurgy of the two metals. (And would not a more logical arrangement be for these to follow the chapters on the chemistry of the metals ?)

The properties of uranium and thorium are described in chapters that give the background physical metallurgy for what constitutes the climax of the book, an excellent account of the use of these materials and their alloys and compounds as nuclear fuels and of the fuel elements in which they are incorporated. The author has surveyed in these last chapters an extensive range of important topics including the economics of various kinds of reactor, the selection of canning materials for fuel elements, and the types of fuel element used in the various reactors of the nations with active nuclear power programmes. It seems a pity that some of the more complex of these topics, such as irradiation damage, were not given more space at the expense of the technical details of extraction processes given earlier in the book.

Pump Users Handbook. By HERBERT ADDISON, O.B.E., M.Sc., M.I.C.E., M.I.Mech.E. Sir Isaac Pitman and Sons, Ltd., Parker Street, London, W.C.2. Price 30s. net.

THIS handbook has been sponsored by the British Pump Manufacturers' Association with a view to assisting pump users, particularly those in charge of installation and running of plant. In an introductory chapter there is given a brief description of each type of pump and its components and subsequent sections deal in particular with pump installation and maintenance, the diagnosis of troubles, performance and testing. The book concludes with useful tables and data and a list of manufacturers and the types of pumps they make.

Optimale Stufenrädergetriebe für Werkzeugmaschinen. By E. STEPHAN. Springer-Verlag, Berlin-Wilmersdorf, Heidelberger Platz 3, German Federal Republic. Price DM.21, cloth DM.25.

THE practical designer of a gearbox is faced with the task of finding the best possible combination of a number of technical and economic requirements. The present book is based on the R. Germer's *Die Getriebe für Normdrehzahlen* (Springer, 1932), in which the laws of geometrical gear progressions were first established. There are two main aspects which Dr.-Ing. Stephan deals with in succession. The first part of the book concerns questions of design calculation, the principal forms of gear trains and their properties, layout and the influence of gear ratios and number of stages on the design of wheel pairs. The second part deals with practical design problems. Both parts are illustrated by worked examples.

Diesel Plant Operators' Handbook. By A. K. L. McCRONE. Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, London, W.C.2. Price 20s.

THIS book gives the operator of diesel-electric power plant the essential facts about such equipment in concise and simple form, in which theory and general practice are combined so as to interest those dealing with design and layout and those concerned with maintenance and operation. After dealing with the principles of electricity, magnetism and electric generators, the book describes electrical instruments in general before going into the main details of power plant operation. There is a chapter devoted to the maintenance of electrical equipment, followed by general notes on the diesel engine. Working systems form the next section of the book, in which starting, cooling, lubrication and fuel oil systems are discussed and analysed, together with an examination of silencing problems and waste heat recovery arrangements. Succeeding chapters are concerned with operating procedures, turbo-charging and the general particulars of lubricating and fuel oils. Appendices are informative upon power plant terminology, aspects of engine performance, formulæ and useful data.

Mobile Radio Telephones. By H. N. GANT. Chapman and Hall, Ltd., 37, Essex Street, Strand, London, W.C.2. Price 21s.

COMMERCIAL v.h.f. radio has shown its value in so many organisations where communication has to be maintained with mobile units that there is a growing need for executives to understand both its possibilities and its technical language. The author assumes in his readers a basic knowledge of broadcast receiver principles, and he does not therefore deal with textbook circuitry, but embarks at once on matters such as methods of working, types of modulation, signal/noise ratio, and forms of interference. All these matters are discussed with evident understanding of prospective users' needs and of the importance of striking a satisfactory balance between cost and performance when choosing an installation. Simple diagrams are used to explain parts of the text, and several receiver and transmitter arrangements are shown in block form, although there are also folding plates showing the circuits of a typical phase-modulated receiver and transmitter. A final chapter on maintenance and testing assumes a little more specialised knowledge in the reader and is intended to make the book useful to the installation and maintenance engineer when setting up or testing equipment. Many readers other than those with installations in view will find the book a useful guide to current practice in commercial v.h.f. radio. It is not intended as a radio textbook, but for those whose interests in this direction have, perhaps, fallen behind the more recent developments, it will serve as a helpful manual of revision.

Vacuum Metallurgy. Edited by R. F. BUNSHAH. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 100s.

ENGINEERS will welcome this book because the field of vacuum metallurgy has been expanding so fast during the past ten years. Much new equipment for handling metals on an industrial scale will be required, using techniques of very high vacuum at high temperatures with constant electronic control. The development of improved methods for attaining the essential very high temperatures and very low pressures in novel industrial scale equipments will lead to a new era in the extraction and refining of metals. Expansion of the use of molten refining and degassing methods may be confidently expected for many of the more conventional alloys, and these new techniques have already become absolutely indispensable for the high quality production of the more reactive metals and alloys now coming into use in nuclear energy projects. In the expanding powder metallurgy fields also, vacuum sintering methods will become increasingly important.

There is in many industries a fascinating interplay between engineering and metallurgy. Here it has been the increasing availability of highly efficient vacuum pumping systems which has made possible the most notable advances in the arts of making, shaping and treating metals and alloys under vacuum or at least under much reduced pressures. Metals such as titanium and zirconium, which were laboratory curiosities only a decade ago, have become engineering materials largely because vacuum technology has been successfully applied to metallurgical processes.

It was the recognition of this fact which led the Department of Metallurgical Engineering of the New York University College of Engineering to sponsor a one-week course on all phases of the subject of vacuum metallurgy in June, 1957, and a second, similar, course was held in 1958. The writers of the twenty-eight papers, which were prepared to cover the fields of these courses in a systematic manner, came from the U.S.A., Europe and Russia. Their lectures have subsequently been edited to form this well-printed, -illustrated and -indexed volume. It contains an extensive bibliography but can claim to be the first book to cover the field so adequately.

The first eleven papers deal with the basic vacuum equipment, thermodynamics, kinetics and arc melting processes. They are followed by eight papers on induction melting, electron bombardment melting techniques and on degassing of liquid or solid metals. Then after a chapter on the distillation of metals, there are seven papers on metallurgical applications of vacuum processing. The section on analytical techniques for vacuum processed metals and alloys is perhaps the key to practical control but intended for the specialist. Others will be more interested in the concluding chapter on future trends in vacuum metallurgy.

The writers of all these twenty-eight sections are appropriately named in the book. Those responsible for its production plan that it will be followed by others in a series which is to cover the technology of metals, ceramics, semi-conductors, high polymers and other materials, having in mind their applications in engineering design.

Einführung in die Ultrarotspektroskopie. By DR. W. BRÜGEL. Second revised and enlarged edition. Verlag von Dr. Dietrich Steinkopff, Holzhofallee 35, Darmstadt. Price (paper back) DM.49; (bound), DM.52.

THE present volume forms No. 62 of the Natural Sciences series of "Wissenschaftliche Forschungsberichte," founded by R. E. Liesegang over thirty-five years ago and edited by him until his death in 1947. It has been the aim of these "Reports" to form links between the various branches of modern natural science and medicine. Such links are formed nowadays by the universally employed methods of physical measurement. Volume 62 was first published in 1954 as an introduction for those who are about to take up infra-red spectroscopy. Since to include all the theoretical ramifications of the subject would have necessitated a work of several volumes, severe restrictions had to be imposed, thus, e.g., Raman and microwave spectroscopy are omitted. The book falls into four parts. A theoretical introduction deals with the basis of the subject in quantum theory, and the vibrational and spectral properties of diatomic and multi-atomic molecules.

The second portion deals extensively with instruments and techniques of preparation; this is followed by chapters on practical applications: the elucidation of chemical structure, qualitative and quantitative analysis and reflection, polarisation and microspectroscopic measurements. Lastly, the author discusses the results obtained in the case of important groups of substances, substances of high molecular weight, and inorganic compounds, and describes special effects and applications. An extensive reference section covers the technical and methodological literature of the subject—as opposed to that concerning its applications, to which references are available elsewhere—up to and including 1956 and, in some cases, the spring of 1957.

Einführung in die Technische Thermodynamik. By ERNST SCHMIDT. 7th edition. Springer - Verlag, Berlin - Wilmersdorf, Heidelberger Platz 3. Price DM.30.

PROFESSOR E. Schmidt's *Introduction to Technical Thermodynamics and the Basis of Chemical Thermodynamics* (also available in English editions), is based on the author's lectures at the technical universities of Danzig, Brunswick and Munich. After a thorough treatment of classical thermodynamics, and its applications to prime movers, the book deals with jet and rocket propulsion and the elements of gas dynamics as well as chemical thermodynamics from the engineer's point of view. Working of the examples is facilitated by the large number of tables, including extracts from the 1956 VDI steam tables which extend to 800 deg. Cent. The present seventh edition is based on the 1948 "International System of Units" (metre, second, kilogramme mass, ampere, and degree Kelvin). All formulæ are expressed in dimensionally correct form and the use of dimensional constants is avoided.

Books Received

Produktenboek 1958. Association of Metalworking Industries, 13, Nassaulan, The Hague, Holland. Free.

Basic Electricity in Five Parts. The Technical Press, Ltd., 1, Justice Walk, London, S.W.3. Price for set, 55s.

Welding Handbook Part 2. Fourth Edition. Cleaver-Hume Press, Ltd., 31, Wright's Lane, London, W.8. Price 72s.

Jigs, Tools and Fixtures. Fifth Edition. By P. Gates. The Technical Press, Ltd., 1, Justice Walk, London, S.W.3. Price 30s.

Technology of Printed Circuits. By P. Eisler. Heywood and Co., Ltd., Carlton House, Great Queen Street, London, W.C.2. Price 60s.

Fundamentals of Pipe Drafting. By C. H. Thompson. Chapman and Hall, Ltd., 37, Essex Street, Strand, London, W.C.2. Price 28s.

Fundamentals of Advanced Missiles. By R. B. Dow. Chapman and Hall, Ltd., 37, Essex Street, Strand, London, W.C.2. Price 94s.

Plane and Geodetic Surveying. Fifth Edition. By D. Clark. Constable and Co., Ltd., 10, Orange Street, London, W.C.2. Price 32s. 6d.

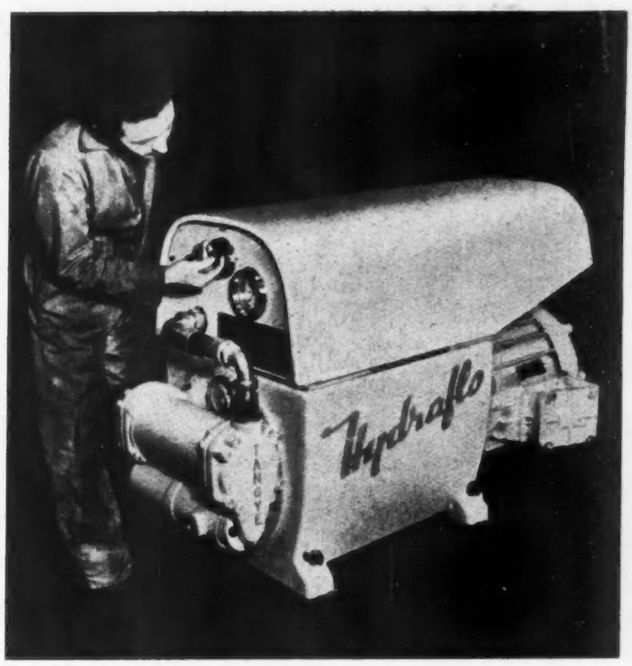
The Individual and the Universe. By A. C. B. Lovell. Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 10s. 6d.

The British Shipbuilding Compendium. 1959 Edition. The Shipping World, Ltd., Effingham House, Arundel Street, London, W.C.2. Price 20s.

Aerodynamik des Flugzeuges. By H. Schlichting and E. Truckenbrodt. Springer-Verlag, Berlin-Wilmersdorf, Heidelberger Platz 3, German Federal Republic. Price DM.52.50.

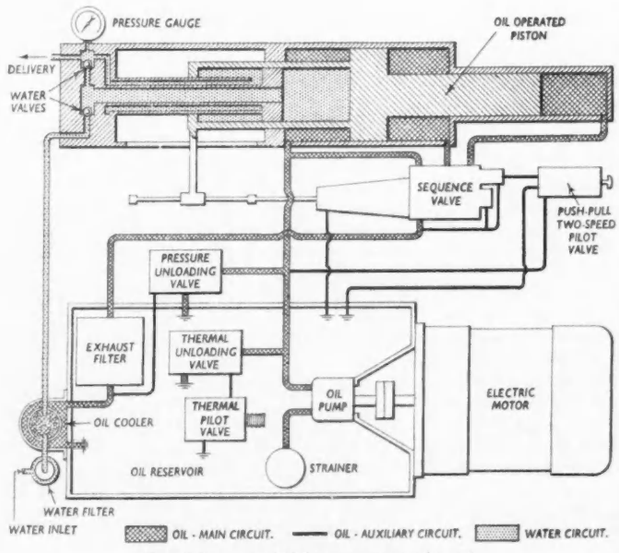
High Pressure Pumping Set

A high pressure pumping set developed by Tangyes, Ltd., is designed to deliver 1000 gallons per hour of water at 1500 lb per square inch, or 500 gallons per hour at 3000 lb per square inch. In this pumping set reciprocation is effected by a piston actuated by high pressure oil and arranged in line with the water pumping cylinder. The speed of the oil pump is constant over a complete cycle, giving almost straight line continuous output. The compact construction made possible with the new design can be seen from the illustration on the right which shows a set supplied to the National Coal Board.



A HIGH pressure water pump which has been developed by Tangyes, Ltd., Smethwick, Birmingham, is a distinct departure from the traditional conception of a reciprocating pump in that mechanical parts, such as crankshafts, connecting rods or reduction gearing, have been replaced by oil hydraulic power to reciprocate the plunger. The first two pumping sets to this new design have been made for deep hole coal seam infusion duties to the requirements of the National Coal Board, and one of these can be seen in the illustration on this page. Each of these pumping sets is driven by a 25 h.p. 1450 r.p.m. motor and is capable of delivering up to 1000 gallons of water an hour at 1500 lb per square inch or 500 gallons per hour at 3000 lb per square inch. The compact design can be seen from the illustration above, and the complete set, which has overall dimensions of 5ft 2in by 2ft 2in by 3ft 2in, weighs only 25 cwt in full working order. The makers state that developments being considered for the immediate future envisage the construction of sets for delivering up to 3600 gallons of water an hour at pressures of up to 6000 lb per square inch, and using powers of 50 b.h.p.

A circuit diagram we reproduce gives a general idea of the principle upon which these " Hydraflo " pumping sets are designed. A high speed oil pump directly coupled to the driving motor draws oil from the reservoir tank through a suction strainer. This pressure oil is delivered to a sequence valve which controls the flow to the " driving " cylinder to reciprocate a piston assembly. The oil operated piston assembly is integral with the water cylinder so that pumping is effected as it reciprocates. A mechanically operated trip mechanism coupled to the sequence valve effects the reversal of stroke during pumping. This trip mechanism ensures self-starting under all conditions, and its action is controlled by dampers to give a smooth and quiet change-over. This trip gear is operated by tappets which are actuated by sleeves mounted on a banjo unit attached to the end of the oil piston rod assembly and reciprocating with it.



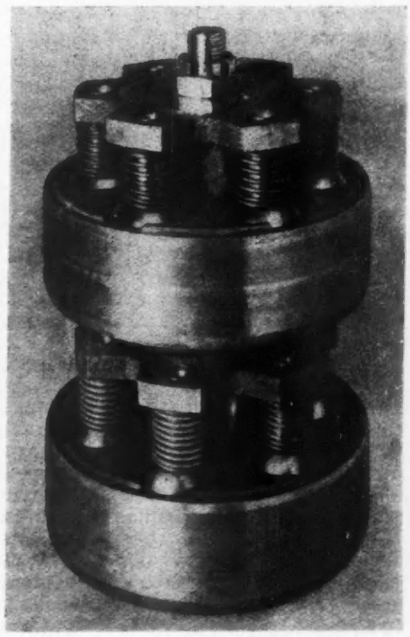
Circuit diagram of high pressure pumping set

To provide the two alternative pumping capacities a control valve spool, operated by a push-pull pilot valve, is fitted in the sequence valve assembly. The wing design two-speed valves brought into operation by the pilot valve work in renewable valve seats.

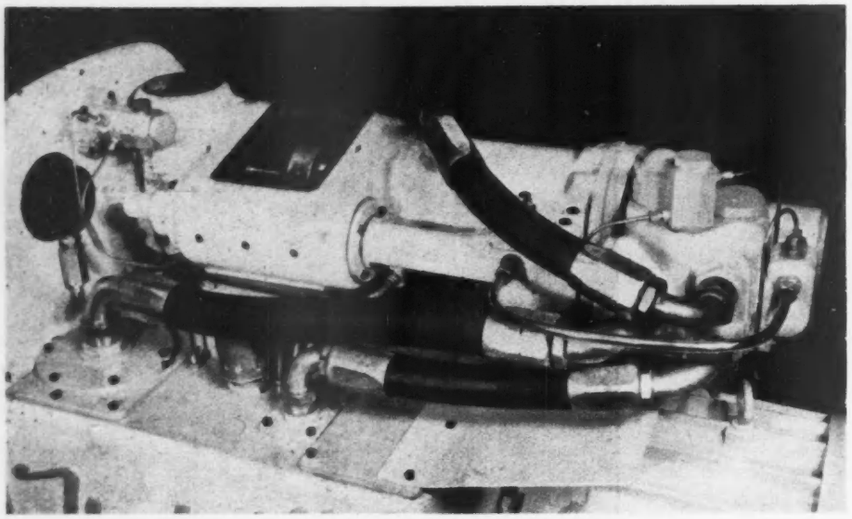
The valve box of the water cylinder can be seen in one of our illustrations. It is a complete, easily withdrawn, assembly, fixed in position by a single bolt, and is made of high tensile cast iron with renewable bronze seats for the stainless steel balls. The use of multiple balls is designed to minimise the valve lift and allow restricted flow and quiet operation.

Overload protection is provided by an automatic pressure unloader valve which permits oil to flow freely back into the tank from the oil pump, with little resistance. It is brought into operation when loading exceeds a marginal allowance over normal duty and so prevents the pump from continuously blowing through a relief valve when overloaded. This valve is designed to allow the pump to idle, taking little power and to restart the pump automatically when the pressure is reduced. A thermal unloading valve included in the oil circuit is designed to come into effect to prevent overheating of the oil should the pump be left untended for long periods.

Oil returning to the tank from the pump passes through a filter and a cooler in which



Water suction and delivery valve assembly



Reciprocating pump assembly with canopy and gland inspection cover removed

a flow of cooling liquid is maintained from the water inlet line to the pump.

All of the dynamic seals used are of metallic design and the rubbing surfaces are hard chrome plated or of close grained cast iron. As all working parts rely upon hydraulic fluid for operation they are automatically lubricated and need no routine attention. The self adjusting seals fitted need only be replaced where performance is affected or visible leakage from the water gland becomes excessive. The hydraulic oil tank provides a mounting for the electric motor and the oil pump inside the tank is mounted on a cover which also houses the flexible coupling. Within the tank are housed the suction strainer, full flow pressure Micronic filter, unloader valves, thermal unloader and thermostat. The other end of the tank is blanked off by a cover which carries the oil cooler, water filter and oil level indicator. The total enclosure of all working parts prevents ingress of dirt or damage on site, and a strong canopy is fitted to protect the pump, pipes and auxiliaries shown in another of the illustrations.

Electrical Engineers' Exhibition

No. II—(*Continued from page* 423, *March* 13)

In opening the exhibition at Earls Court on March 17, *Lord Brabazon of Tara recalled that the electrical industry was the second largest exporter in this country, its exports being exceeded only by the motor industry, but whereas saturation in the market for motor vehicles might be foreseen, there would be no slackening in the world demand for electrical products. It was announced at the ceremony that the first prize in the industrial section had been awarded to the Brush Electrical Engineering Company, Ltd., for its dry flameproof transformer for mines, and in the domestic section to Dimplex, Ltd., for a portable infra-red fire.*

Heenan and Froude, Ltd.

A NEW adjustable speed fractional-horsepower drive and a range of stationary-field eddy-current couplings are among the exhibits shown by Heenan and Froude, Ltd., Shrub Hill, Worcester.

The " Adjusto-Spede " drive, as it is called, is designed for use with a.c. mains and it provides a smoothly variable speed over a wide range. It consists of a fixed-speed, single-phase or three-phase induction motor mounted integrally with an eddy-current variable speed coupling in a drip-proof housing. The motor and the coupling input member run at constant speed, whilst the speed of the output member is infinitely variable. A small tachometer generator is built into the housing and the variable speed shaft extends through the unit so that power is available at either end. The overall length of the drive unit is approximately 15½in and the diameter of the housing about 6½in.

The controller, which measures 5in by 5in by 6½in, may be mounted remotely from the drive.

Control of the speed of the shaft is effected by varying the d.c. input to the field coil of the coupling. A grid-controlled thyratron is used both for the rectification of the a.c. supply and for the control of speed. A reference for the feed-back system is derived from the tachometer generator mounted in the motor housing. It is stated that this drive can be expected to hold its speed to within 1·5 per cent (at 1200 r.p.m.) from no-load to full load. This load-holding characteristic is illustrated by typical curves reproduced in Fig. 9.

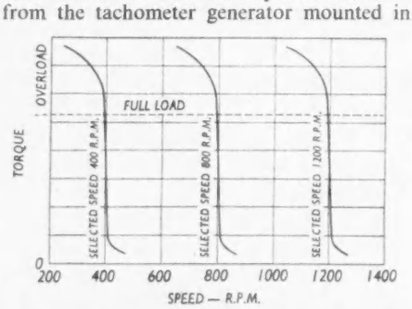


Fig. 9—Load holding characteristic of "Adjusto Spede" fractional horsepower drive—Heenan and Froude

The stationary-field eddy-current coupling (Fig. 10) is mounted as one unit with a standard D-flange squirrel cage induction motor. The coupling excitation coil and supporting field body are fixed to an end housing. A U-shaped toothed rotor mounted on the output shaft rotates concentrically around the stationary-coil member and is separated from it by two concentric air gaps. An air gap also separates the drum ring assembly (which is keyed to the driving motor shaft) from the outer periphery of the rotor or field magnet. This ring rotates concentrically around the field magnet. When current is flowing in the excitation coil torque is transmitted to the output shaft and the torque depends on the current.

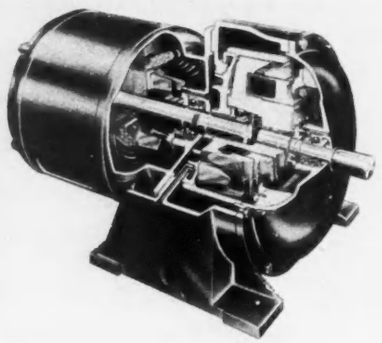


Fig. 10—Cut-away view of stationary field eddy-current coupling (right) integral with a flange-mounted induction motor (left)—Heenan and Froude

By mounting a small tacho-generator on the output shaft a separate magnetic amplifier or electronic control system can be applied to provide close speed regulation over the whole load range.

Johnson and Phillips, Ltd.

A special feature of the range of switchgear shown on this company's stand is the new Johnson and Phillips 150MVA, 3·3kV arc-control, oil circuit breaker (Fig. 11), suitable for the control of power station auxiliaries, colliery pithead installations, &c. External dimensions are similar to the small and compact Johnson and Phillips type TDB16 plain-break oil circuit breaker, and the new unit can, in fact, be used in the same housings for both air-insulated and compound-filled, single or duplicate busbar metal-clad switchboards. It is of double-break design with moving contacts of solid round rod making into a circular configuration of finger contacts backed by helical springs, fixed around the stationary contact blocks. An efficient buffering system cushions the moving contacts when the breaker opens under fault conditions.

The top plate and tank are of fabricated steel plate construction proportioned to withstand internal pressures resulting from fault clearance. The three phases are segregated from each other within the tank by barriers of rectangular tube form. The top plate forms a complete housing for the contact lifting mechanism of the breaker, which consists of a simple bell-crank arrangement, and provides an expansion chamber for cushioning the impulse set up under

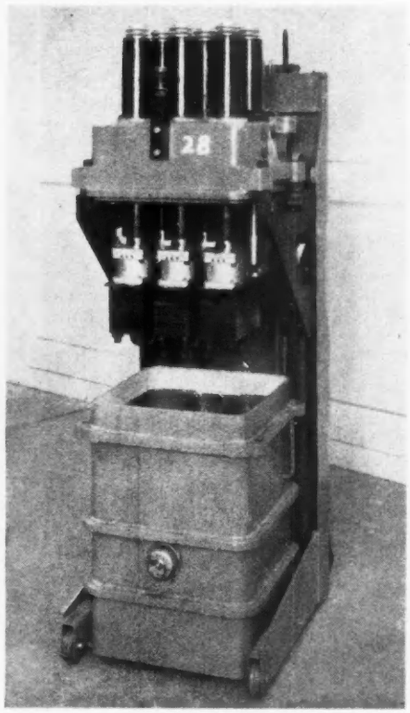


Fig. 11—150MVA, 3·3kV double-break design oil circuit breaker with improved cross-jet arc control—Johnson and Phillips

short-circuit conditions. The toggles necessary to reduce the forces of tripping are contained within the external operating mechanism and not within the breaker.

Solenoid or spring-operated mechanisms are available. These are interchangeable, and a solenoid magnet can be changed for a power spring device without disturbance to the main operating mechanism. All mechanisms are free-handle and arranged to accommodate most forms of trip-release. Cast epoxy resin or synthetic resin-bonded paper terminal bushings can be supplied.

Ferranti, Ltd.

The electronics department of Ferranti, Ltd., is showing for the first time a selection of klystrons which are used in all types of radar equipment. These were developed in conjunction with the Royal Radar Research Establishment and the Admiralty. The reflex klystron illustrated (Fig. 12) is the VA-201B (manufactured under licence from Varian Associates, U.S.A.), a highly shock-resistant unit of 50mW power output covering

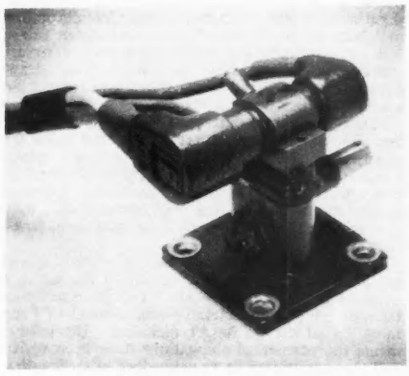


Fig. 12—Reflex klystron for airborne applications including local oscillator duty—Ferranti

the range 8500 to 9000 Mc/s. It can withstand shocks of over 250g. The single-screw tuner requires no locknut and the klystron is suitable for use as a local oscillator in airborne applications. Characteristics of the design are high-frequency stability and low noise under the most severe environmental conditions. Heater voltage is 6·3V and current 1·2A. Maximum resonator voltage is 350V, resonator current 55mA maximum and reflector voltage 0V to 500V.

Transformer exhibits include a type DC3 on-load, three-phase tap changer for 33kV transformers operating on the high-speed resistor transition principle. The unit can be used in either star or delta operation at a maximum full-load line current of 300A on normal tapping and with a maximum of sixteen steps. The tap changer, which is completely self-contained, can be bolted directly to the transformer tank.

Among exhibits from the Meter Department are the recently developed remote reading meter and billing meter. The first of these is a house service meter with repeater dial which can be read from the outside, thereby eliminating the cost of unproductive calls made by meter readers when premises are unoccupied. The repeaters are Post Office message recorders operated by impulses transmitted from contacts fitted to the house service meters. The second of these devices, the billing meter, enables quarterly or monthly accounting to be made in accordance with established custom. In operation the consumer inserts a card supplied by the Electricity Board into the slot in the meter, the handle is turned and the card is withdrawn bearing a printed record of the kilowatt-hours registered.

Transformers (Watford), Ltd.

A Jansen type transformer on-load tap-change equipment, manufactured by Maschinenfabrik Reinhausen, Gebruder Scheubeck K.G., Regensburg, is shown for the first time in this country on the stand of Transformers (Watford), Ltd., Sandown Road, Watford, Herts, through whom these equipments are obtainable. The cylindrical form of construction seen in the illustration (Fig. 13), provides maximum mechanical and electrical strength in a small compass and enables the equipment to be accommodated inside the transformer tank, immediately adjacent to the windings, so that the tapping leads between the windings and the tap changer are of minimum length, obviating the need for an external tap changing equipment pocket. The drive head and driving mechanism project only a few inches over the tank cover, so that clearances to bushings and overhead equipment are virtually unaffected. This arrangement leaves the sides of the transformer tank free for the accommodation of ancillary equipment such as cooling equipment and cable boxes. The equipment is oil-immersed and the oil inside the cylindrical container housing the current-breaking diverter switch contacts and transition resistors is isolated from the oil in the main transformer tank. Any oil which may be fouled by the contacts breaking current is collected in a cylinder at the base of the equipment from which it can be withdrawn through a valve outside the transformer tank. This operation can be carried out whilst the transformer is on load and is the only routine maintenance required.

Tap-changing is carried out by the high-speed resistance transition method. Operation is through an energy-storage mechanism which, when released, completes the tap change in a small fraction of a second. This occurs independently of the motor drive, so that it is not possible for the equipment to remain in an intermediate position should the auxiliary supply fail. The time interval for a complete cycle from initiation by push-button or voltage relay is only a few seconds.

The combined drive mechanism for electrical and hand operation is contained in a compact weatherproof cubicle mounted on the transformer tank side. When the hand crank is inserted and engaged the motor control supply is automatically isolated. On removal of the crank, electrical operation is

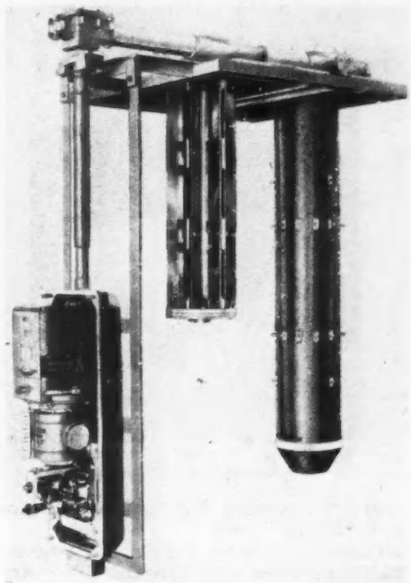


Fig. 13—On-load tap-change equipment of the Jansen type showing cylindrical form of construction—Transformers (Watford)

restored by a resetting action. The drive to the equipment is through a differential gear, which at the end limit position is mechanically released, so that the mechanism runs free. In addition, limit switches are provided in the control supply to prevent the equipment from being operated electrically beyond the end limits.

Step-by-step operation is achieved by a changeover switch operated by the drive mechanism in conjunction with a resetting relay so that a step must be completed before the next step can be initiated. Full parallel operation can be provided, and protection against out of step operation of units in parallel is incorporated.

The wire-wound transition resistors are oil-immersed in the switch cylinder and are rated so as to be capable of repeated tap changes in quick succession, being capable of carrying six to nine times the transformer normal winding current during transfer switch operation.

Brookhirst Igranic, Ltd.

Among the new products on the stand of Brookhirst Igranic, Ltd., Park Lane, London, are examples of the "BI-stat" system of static control units for the control systems of complicated tools and other applications. Fig. 14 shows a machine tool control cubicle, built to customer's requirements, incorporating this form of gear. In this illustration may be seen the "BI-stat" logical units which replace conventional relays and timers, mounted in the rear of the cubicle. These units are entirely devoid of contacts and moving parts and work at safe low voltage and power levels. The "BI-stat" control

system collects and processes all information, whilst power control is effected by contactor equipment assembled in the front of the same cubicle.

Also displayed are two working models illustrating push-button control and interlocking carried out by " BI-stat " units, and the accuracy of control achieved by proximity limit switches working in conjunction with " BI-stat " units.

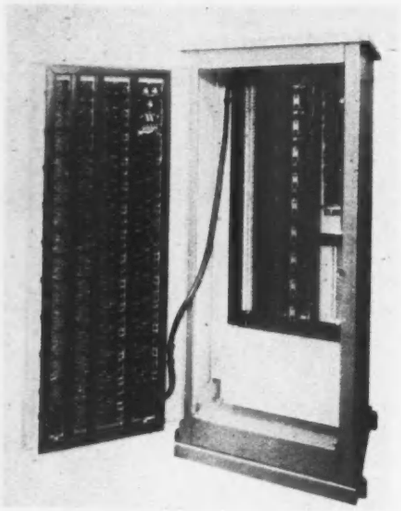


Fig. 14—Machine tool control cubicle incorporating static logical units in place of conventional relays and timers—Brookhirst Igranic

Other items shown for the first time are additional fitments for 25A and 50A " Arcmaster " contactors, including latch-in mechanism, mechanical interlock for reversing duty, &c., d.c. magnet, mechanical indicator, and " Trulag " timing relay. The " Optor " crane hoist and travel control panels using block contactors, are also newly-introduced, and demonstrate the reduced dimensions of control panels for medium and smaller size cranes now being provided by Igranic.

The English Electric Company, Ltd.

Among several new items shown by the Fusegear Division of the English Electric Company, Ltd., Marconi House, Strand, London, W.C.2, is a heavy-current, off-load isolator (Fig. 15), with new safety features. Being of compact dimensions, the isolators can be readily built into " Combination " and " Superform " switchboards. The ratings of 1200A and 1600A are suitable for use with 750kVA and 1000kVA transformers on 400/440V, three-phase supplies. Of the several safety features incorporated, the most important is the provision of insulated shutters which completely blank off the fixed contacts when the isolator is in the " off " position. At this stage the operating handle can be padlocked so that complete safety is assured for anyone working on the equipment controlled by the isolator.

When tested for short circuit capacity, the new design has successfully withstood through fault currents of 46kA for three seconds and has afterwards been found satisfactory for further service without adjustment.

The same division of the company is showing a new range of load-breaking fuse switches which have been specially designed for the Canadian market and are C.S.A. approved.

Other new items on the stand include a " 9350 " series washing machine motor and maximum demand meters, among the latter being a single-phase meter with thermal demand in an all-insulated house service pattern case, suitable for small industrial, commercial and domestic consumers. An addition to the range of polyphase meters is a 100A meter with an auxiliary terminal block having ½in diameter terminal holes for direct connection.

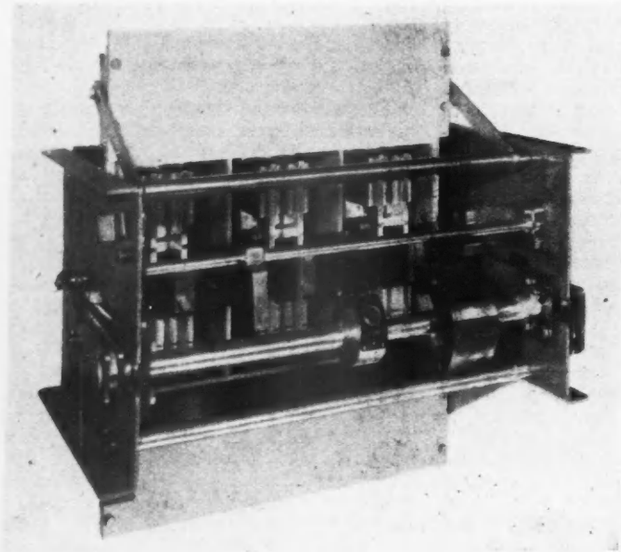


Fig. 15—Chassis of 1200A triple-pole isolator. The raised shutter is lowered to screen the fixed contacts when the isolator is open—English Electric

Allen West and Co., Ltd.

The driver's crane controller illustrated in Fig. 16 is a new plug-in design by Allen West and Co., Ltd., Brighton, 7, which can be removed from the control unit for inspection and maintenance in a few seconds without disturbing any connections. Controllers can therefore be mounted close together so as to occupy minimum space without impairing accessibility. The standard controller has a welded sheet steel enclosure, but can be supplied as an open type unit for mounting in the customer's own housing. In the controller unit, the main operating shaft carries machine-cut moulded cams which actuate the contact units. Each moving contact lever is operated by the action of a cam against a lever roller. Contacts are double-break, silver-faced, and close under heavy spring pressure. The contact assembly forms a single integral unit, independent of the main camshaft and terminal bar, and is secured by two screws only. When the complete unit is in position, contacts at the bottom of the controller plug into corresponding spring-loaded contacts on the terminal block. It can be removed by slackening two knurled retaining screws. Controllers of types " PNMC " and " PMC " have a maximum of seven notches. Type "PUMC" has a maximum of six notches and comprises two controllers disposed end-to-end, the driving shaft for the bottom unit being concentric with the top controller camshaft. In all patterns the notches are registered by a pawl mechanism.

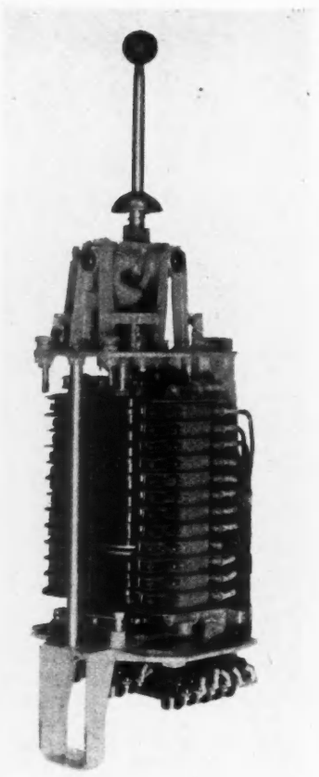


Fig. 16—Vertical-mounting, plug-in controller for crane, shown removed from driver's control unit —Allen West

The company is also showing an improved dual-motor " ALJEK " crane control scheme and additions to its range of push-button controllers one of which presents a pictorial representation of the machine tool controlled.

(*To be continued*)

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1.

STEEL BOILER AND SUPERHEATER TUBES

No. 3059 : 1958. Price 8s. 6d. This new publication contains twelve separate and separately numbered specifications—six being for carbon steel tubes and six for molybdenum steel tubes, of varying form and tensile strength. It thus makes available under one cover the material formerly dealt with in : B.S. 494—Cold drawn seamless mild steel boiler and superheater tubes ; B.S. 512—Hot finished seamless mild steel boiler and superheater tubes ; B.S. 1652—Seamless half-per-cent molybdenum steel boiler and superheater tubes ; B.S. 1653—Seamless chromium-molybdenum steel boiler and superheater tubes ; B.S. 1654—Electrically welded mild steel boiler and superheater tubes ; and B.S. 1678—Cold drawn electrically welded mild steel boiler and superheater tubes.

It also contains requirements for hot finished seamless and cold drawn seamless carbon steel boiler and superheater tubes (27 tons per square inch minimum tensile strength) ; and for hot finished seamless and cold drawn seamless 2¼ per cent chromium, 1 per cent molybdenum steel boiler and superheater tubes (27 or 31 tons per square inch minimum tensile strength).

The standard follows the present practice of designing on the basis of the temperature of the metal, as opposed to that of the steam. Temperature limitations on the use of electrically-welded tubes of " rimming " steel are no longer included. The requirements for percentage elongations have been revised and they are related to an equivalent gauge length of four times the square root of the area of the test piece. Modifications have also been made to the requirements for the expanding test on tube ends.

High-Voltage Electrostatic Generator

A DEMONSTRATION was given recently at Shoreham of high-voltage electrostatic generating equipment now available through Miles Hivolt, Ltd., 91, Princedale Road, London, W.11. The equipment is manufactured by Société Anonyme de Machines Electrostatiques (S.A.M.E.S.) of Grenoble, for whom Miles Hivolt, Ltd., is concessionnaire for Britain and Commonwealth countries.

The principal item shown was the new S.A.M.E.S. 600kV generator, CD600-4. In this machine, as shown in Fig. 1, a rotor of

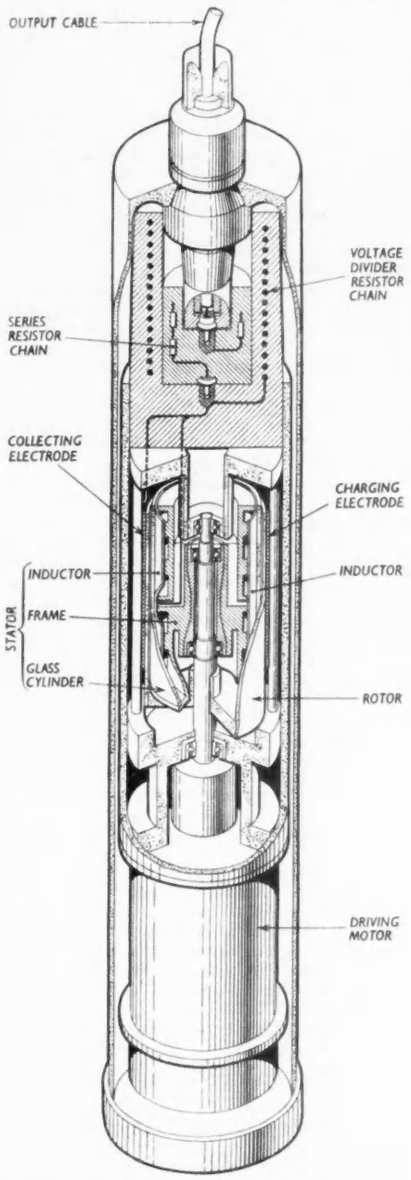


Fig. 1—Internal arrangement of two-pole generator

insulating material is contained within an insulated pressure vessel, which is filled with hydrogen at a pressure of 300 lb per square inch. The rotor is driven by a 2800 r.p.m. induction motor and conveys the positive charges received at the charging poles to the output poles, inducing a rise in potential as in the simple form of influence machine. Commutation takes place without rubbing contact, by means of ionisers in the form of thin blades placed a short distance from the rotor.

The associated excitation and control equipment, indicated in Fig. 2, is all-electronic. The excitation circuits produce an output of up to 25kV d.c. which is used to produce ionisation in the pressure vessel, this effect being used both to apply the charges and transfer the output to the external circuit, so that no rubbing contact with the cylinder is required. Ionisation does not take place until the output of the exciter has reached 13kV. This potential is applied between the electrodes on each side of the rotating insulated cylinder, and by causing ionisation enables charges to be transferred to the cylinder surface.

Control of the machine output is effected by using a selected feedback voltage derived from the potentiometer shown in Fig. 2, as a reference, and causing this to adjust the excitation voltage. The whole range of output from 0kV to 600kV is obtained by varying the excitation between 13kV and 25kV. The instruments on the control desk, seen in Fig. 3, comprise an excitation voltmeter, output voltmeter and a milliammeter. Coarse and fine controls are provided for setting the desired output by acting on the excitation voltage in the manner described. Starting and stopping of the generator is effected by means of push-buttons. The operator also has at hand a cut-out control for adjusting the current overload device. Protective circuits for output and excitation voltage are adjusted in the factory. The action of a single thyratron is arranged to stop the machine in the event of any of these limits being exceeded. The equipment also includes a protective circuit which is sensitive to high-frequency oscillations set up by sparking, and, in the event of these occurring, lowers the voltage until sparking ceases.

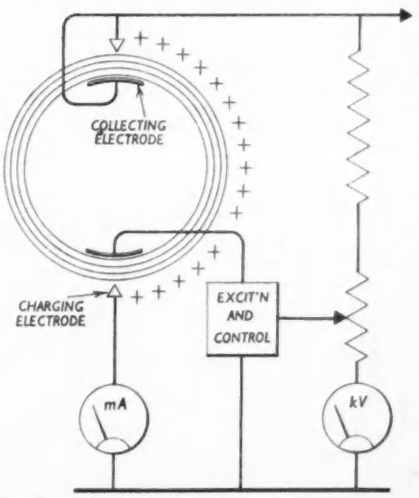


Fig. 2—Basic circuit of generator and control system

Due to its relatively small size and low weight, a little over 2000 lb, the generator is convenient for the testing of cables and switchgear. When assembled in a small vehicle it enables field tests on high voltage transmission lines to be carried out. In addition, the generator may be used as a high-voltage accelerator for both ions and electrons. In the former application the accelerator can provide a neutron source which can be switched on and off at will.

The introduction of this and similar machines has been undertaken to meet the increasing demands from industry for high-voltage facilities, arising from the development of nucleonic techniques and the wider need for local production of industrial isotopes.

Stability of the generator as demonstrated is

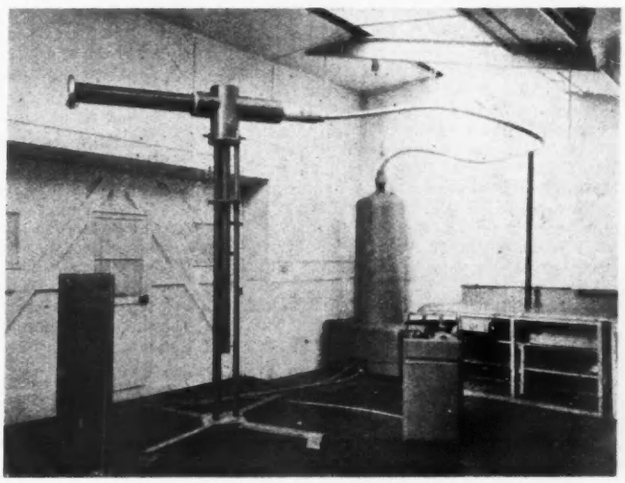


Fig. 3—600kV equipment showing generator (in background), electronic cubicle (left foreground) and control desk (right foreground)

approximately one part in 10^3, but a high-stability unit can be incorporated in the same design of equipment. A 50kV Samtron generator was also shown which provides a stability of one part in 10^5.

PHOTO-ELASTICITY AT UNIVERSITY COLLEGE, LONDON.—Fifty years ago the late Professors E. G. Coker and L. N. G. Filon began their collaboration in the development of the photo-elastic method of stress analysis. The jubilee is to be celebrated at University College, London, where most of the work was carried out, by a commemoration lecture and an exhibition of work in photo-elasticity at the college. Sir Arnold Hall, president of the Royal Aeronautical Society, will preside at the commemoration lecture, to be delivered by Colonel H. T. Jessop on Wednesday, April 15, at 6 p.m. The exhibition will be on view on April 15, from 7 to 9 p.m., and on April 16 and 17, from 10 a.m. to 1 p.m., 2 to 5 p.m., and 6 to 9 p.m. The lecture and the exhibition will be open to the public.

ESK VIADUCT RECONSTRUCTION.—Work has begun on the reconstruction of Esk Viaduct on British Railways (London Midland Region) main line, 6¼ miles north of Carlisle. The new structure will have thirty-six spans, varying from 22ft flood openings to 30ft over the river, and will consist of a new concrete deck carried by longitudinal steel girders supported on concrete pile bents. The pile bents will be placed between the existing piers and the existing girders will be re-used wherever possible. The piling across the river has already commenced and it is expected that the whole job will take about eighteen months. The existing viaduct is 355 yards long, has thirty flood openings of about 21ft each, seven river spans of about 40ft each, and consists mainly of longitudinal girders with a timber floor resting on sandstone piers. The sandstone piers are part of the original structure, built in 1847, when the Caledonian Line was first opened. The existing steel girders were placed when the superstructure was reconstructed in 1905. The present structure has almost reached the end of its useful life and the piers, which are rapidly deteriorating, have caused difficulties intermittently during the past few years. The cause is considered to be slight settlement of the foundations coupled with the weathering and ageing of the masonry piers, accelerated by the presence of sandstone blocks of inferior quality. From detailed examinations made of both structure and the ground supporting it, the L.M.R. states, it is evident that complete reconstruction is necessary.

SHORTER REPORTS

National Institute of Industrial Psychology Annual Report

THE annual report of the National Institute of Industrial Psychology, presented at the annual general meeting on March 12, indicates that increasing demands for the Institute's services marked the year ended September 30, 1958. It is now clear that the Institute can rely on the maximum possible grant of £8000 from the Department of Scientific and Industrial Research for the current year. (The size of the grant depends on the amount of money already subscribed to the Institute by industry.)

The report shows that the money is being spent partly on long-term research into three issues. The first is an investigation into how people in industry regard the opportunities and rewards offered them ; for example, what one man sees as a stimulating challenge another sees as an unrewarding risk. Remote as this may seem from daily practice, it is a problem which the Institute believes is constantly exercising personnel managers in their efforts to get the best from workers by economic and "status" incentives. One practical application of this research could be the development of personnel policies which genuinely matched employees' expectations and values instead of being regarded as schemes designed solely to suit the management. A second research plan is to try and find how satisfaction in a job affects a worker's efficiency at it, both in individual cases and in comparisons of the performances of groups of employees. This could have an important bearing on the degree to which processes are broken down in "conveyor-belt" production and also on the effects of increasing mechanisation and automation. The third field of research is in management, where Institute investigators hope to find the effect of different kinds of organisational structure on the speed and wisdom with which managers make decisions. This may help to settle current controversies about whether functional or "line" management is best for certain purposes.

Experiments are continuing on the preparation of practical tests which firms can use to predict workers' suitability for manual jobs requiring only simple skill and a capacity to learn to work consistently fast. The Institute hopes also to publish a report soon on another group of tests, used for the selection of engineering apprentices.

In the last year, the Institute has helped firms in a wide range of industries to improve selection of employees, training, organisation, and assessment of managerial, clerical and technical staff. Vocational guidance was given to 586 individuals and courses were held for firms' nominees on selection methods, interviewing, merit rating and certain types of training. The Institute's staff has also lectured to more than 4000 people under the auspices of other organisations.

Education and Careers Exhibition

THE first National Education and Careers Exhibition is to be held at Olympia, London, from May 26 to June 5 inclusive. The exhibition, which is being organised by the National Union of Teachers, is under the patronage of Her Majesty the Queen ; it has the support of the Ministry of Education, the Ministry of Labour, the Federation of British Industries, the British Employers' Confederation, the Trades Union Congress and about fifty major industrial organisations and firms. It is stated that the education section of the exhibition will include live and static displays illustrating all aspects of this country's educational system ; some of the exhibits in this section will emphasise the education and training facilities provided by industry. The careers section of the exhibition is being organised with the co-operation of a number of trade and employers' associations and individual firms, the object being to provide comprehensive information and advice in virtually all the main fields of employment.

Science Laboratory Technicians

THE City and Guilds of London Institute and the Institute of Science Technology announce that they have taken steps to rationalise their examinations and qualifications for science laboratory technicians. Hitherto, both Institutes have held examinations for science laboratory technicians, but in future there will be only one series of examinations, held by the City and Guilds of London Institute on behalf of both bodies. The conduct of the examinations and their further evolution will be under the guidance of a joint advisory committee of both Institutes and the certificates awarded to successful candidates will bear the heading : "The City and Guilds of London Institute in conjunction with the Institute of Science Technology."

Transitional regulations have been agreed to ensure that no student at present preparing for the examinations of the Institute of Science Technology suffers because of the new arrangements. The arrangements for the award of the Fellowship of the Institute of Science Technology remain as hitherto.

The importance of adequate numbers of suitably trained technicians in the nation's science laboratories has been stressed in many quarters and the work of both Institutes has undoubtedly played a notable part in promoting the wider appreciation of the importance of science laboratory technicians and of their special requirements for education and training. The existence hitherto of two broadly similar schemes of examination and qualification has unfortunately dissipated effort. But it is believed that the rationalisation now achieved will be an important step forward, particularly in promoting the successful establishment of courses of study in technical colleges, universities and elsewhere which will permit the technician to be given the comprehensive theoretical and practical training that is essential if he is to attain the highest standards and be competent to furnish the professional scientist with the assistance he requires.

BEAMA Annual Report

THE report for 1958–59 of the British Electrical and Allied Manufacturers' Association (Incorporated), presented at the Association's annual meeting on March 19, shows that in 1958 for the third year in succession exports from the United Kingdom of electrical and allied products totalled over £270 million. The actual total of £276·4 million was a decrease of 1 per cent compared with the preceding year, but was £3,900,000 higher than in 1956. This small decline was not altogether unexpected, for the grand total of all United Kingdom exports fell by about 2 per cent below 1957. Considering individual items, the most notable decrease in electrical goods was in cables and wires, attributed by the cable makers to unusually high orders in the preceding two years. If this item is disregarded, all other electrical exports increased by £7,200,000, or 3 per cent over 1957. Exports to the Commonwealth last year increased from 54·3 to 57·6 per cent, but there was a slight fall in exports to the six Common Market countries.

Exports of heavy electrical machinery in 1958 totalled the record figure of £81,000,000. Included in this was a record figure for exports of steam turbine plant, which amounted in capacity to 1130MW, 24 per cent above the 1957 figure. Steam and water turbines together totalled £10,700,000 as compared with £10,300,000 in 1957. Exports to the North American market were a record in 1958, and more than £10,000,000 of heavy electrical machinery and allied plant was sold to Canada and the U.S.A. These two countries now buy nearly 10 per cent of the industry's total sales abroad.

In 1958 electrical exports formed over 10 per cent of all United Kingdom exports of manufactured products. The industry produced approximately £1,300 million of electrical products—virtually the same as in 1957, although the labour force employed decreased slightly from 729,700 in 1957 to 726,900 in 1958. The decrease was in female employees, since the number of men employed in the industry increased from 457,000 in 1957 to 464,100 in 1958.

Since 1950 the annual production of heavy electrical generating plant in the United Kingdom has increased over 60 per cent, and the annual production capacity of the industry now exceeds 3000MW. The annual rate of commissioning new plant in the United Kingdom is now about 2000MW. The first 120MW set came into operation during 1958 at Blyth, Northumberland ; 200MW sets are in course of construction, and the 550MW generating set which is being built for Thorpe Marsh, Doncaster, is planned to come into commission in 1963. The report notes an announcement by the British Transport Commission that a conference and exhibition will be held in London at the end of 1960, in which eminent railway engineers and operators from overseas will be invited to take part and to see the progress in railway electrification that has been made in this country.

A new BEAMA publication, *Leading the World*, was issued on the occasion of the meeting. This is a complement to *Serving the World*, published last year in connection with the Brussels Exhibition, of which over 40,000 copies have already been sent overseas. Both books are being distributed widely in influential circles in this country, recipients including all Members of the House of Commons and the House of Lords. *Leading the World* is a sixty-eight page book in which the first section describes the electrical industry's participation at the Brussels Exhibition, the second comprises a complete record of the 1958 British Electrical Conference at Brussels, and the third illustrates the industry's contribution to the Geneva Conference on the Peaceful Uses of Atomic Energy. An account of BEAMA activities and a list of member firms concludes the publication.

Telford Gold Medal Award

THE council of the Institution of Civil Engineers has awarded the Telford gold medal —the Institution's highest award—for the session 1957–58 to Mr. Gerald Lacey, C.I.E., B.Sc., M.I.C.E., for his paper, "Flow in Alluvial Channels with Sandy Mobile Beds." Mr. Lacey retired from the irrigation branch of the Indian Public Works in 1942, on reaching the age of fifty-five. He was subsequently engaged as a Lieut.-Colonel in the Indian Corps of Engineers and as principal of the Thomason College, Roorkee. He finally left India in 1947. In 1948 he went on a Colonial Office mission to East and Central Africa, and in the next year to British Honduras. From 1950 to 1958 he was part-time drainage and irrigation adviser to the Secretary of State for the Colonies. Since 1950 he has been a consultant with Sir M. MacDonald and Partners.

Education for Commerce

YESTERDAY there was published a Report of the Advisory Committee on Further Education for Commerce under the chairmanship of Mr. J. G. McMeeking.* In a foreword, Mr. Geoffrey Lloyd, Minister of Education, remarks : "I am at present reviewing the many important recommendations which it makes and hope, shortly, when the necessary consultations have taken place, to announce the Government's decisions."

The committee, in its report, emphasises the increasing intensity of the competition from overseas. "More and more countries are building up their industries and offering for sale goods once considered typically British. Many of this country's European competitors have developed elaborate systems of commercial education and are making intensive efforts to strengthen them." The committee was particularly impressed by the "high schools of commerce" on the Continent which offer full-time university-level courses of at least three years, combining "much of the academic work conducted by the faculties of economics at the universities in this country with the more practical study of commercial knowledge and techniques."

We print below a summary of the committee's conclusions and recommendations.

Great Britain lives by manufacture and trade. Goods have not only to be designed and produced —they must also be financed, sold, insured and distributed.

A great national effort is being made to educate and train scientists and technologists. A similar effort is needed in education and training for commerce. Indeed, it seems to us that successive Governments have, until recently, failed to recognise the need and provide the resources.

Commerce must recruit a higher proportion of intelligent young people and provide them and some of its older employees with better opportunities for education and training.

Commerce must make its educational needs better known to local colleges of commerce and co-operate with them in solving their mutual problems. Colleges of commerce must overhaul and improve their facilities to meet the ever-changing needs of commerce.

The advantages which colleges of commerce have to offer must be brought more effectively to the notice of commerce, industry and the public generally.

The solution of the urgent problem of improving commercial skills requires the fullest co-operation not only of individual employers and colleges but also of the relevant Government Departments, local education authorities, representative bodies of employers, the National and Regional Advisory Councils for Further Education and educational and professional associations.

Sustained action must be taken to overhaul and reinvigorate the existing system of commercial education : vigorous efforts must be made to impress the importance of commercial education upon all concerned—not least upon the young people of this country and their parents.

We recommend that :

(1) Apprenticeship schemes based upon a combination of systematic practical training and commercial education should be developed on a much wider scale.

(2) There should be a great expansion of day release for commercial study, and the present number of students (about 20,000) released in the day time for commercial studies at intermediate level and above increased to 50,000 by 1964 at the latest.

(3) The advantages of block release should be explored, particularly by business concerns who find difficulty in making satisfactory arrangements for day release of employees for education and training.

(4) The Ordinary National Certificate in Commerce should be more widely recognised as providing a sound foundation of general commercial knowledge of benefit to a large number of those engaged in commercial work.

(5) Determined efforts should be made to bring closer together the requirements of the intermediate examinations in general commercial subjects of those professional bodies willing to do so, and of the Ordinary National Certificate in Commerce. A review of syllabuses should be undertaken without delay by the Joint Committee on Awards for National Certificates and the appropriate professional bodies together.

(6) Greater use should be made of the Higher National Certificate in Commerce as a qualification covering both general and specialised commercial knowledge, especially where no precise professional qualification exists.

(7) Sandwich courses combining an advanced commercial education with systematic training should be developed on the lines of those already established in the field of technology.

(8) A new national award to mark the successful completion of a sandwich course in general commercial studies to degree level should be established without delay.

(9) More short refresher and "conversion" courses should be provided. The colleges should promote more courses in up-to-date business practices and techniques with the particular object of assisting the adjustment of small and medium-sized firms to modern conditions.

(10) Colleges should help to offset the disadvantages of isolated study through correspondence courses where arrangements for this purpose are not made by the professional associations.

(11) Courses, particularly with reference to the export trade and for the benefit of small and medium-sized firms, should be developed in the technique of salesmanship and in all aspects of sales management, marketing and distribution.

(12) Intensive full-time courses in modern languages should be established.

(13) Modern languages should be offered as optional subjects in degree level sandwich courses.

(14) Part-time day courses in modern languages should be established for students already possessing a good knowledge of a language.

(15) Instruction in modern languages should be reinforced by instruction in subjects that will help the student to understand foreign business conditions and social customs.

(16) Arrangements for exchanges of commercial apprentices between business organisations in this country and abroad should be encouraged.

(17) Much more support should be given, especially by granting day release, for courses already established in retail distribution subjects.

(18) More opportunity should be given for women to attain professional status in commerce and there should be greater willingness both by employers and their women employees to make use of day release facilities.

(19) Research and consultancy work in the colleges should be developed. The colleges should become focal points for discussion of business problems.

(20) Principals and staffs of colleges should be encouraged to study commercial education and practice abroad.

(21) The appointment of business historians should be considered where appropriate.

(22) College staffs should be strengthened by the recruitment of an adequate number of fully qualified full-time and part-time staff.

(23) Local education authorities should be ready to pay higher fees to highly qualified lecturers for specialised courses, the fees to those attending being raised accordingly.

(24) Local education authorities should use to the full the discretion allowed to them in the grading of teaching posts in colleges of commerce.

(25) Local education authorities should give college governing bodies powers sufficient to attract responsible people from industry and commerce to membership and industry and commerce should encourage their senior personnel to serve on governing bodies and advisory committees.

(26) Additional and more suitable accommodation should be provided at the colleges, and the annual educational building programme so framed as to meet this urgent need.

(27) All colleges should have good libraries adequately accommodated and staffed.

(28) Colleges should be provided with adequate office equipment for teaching and research.

(29) More should be done to publicise the facilities the colleges have to offer.

(30) Sustained action should be taken to overhaul and reinvigorate the existing system of commercial education and to impress the importance of commercial education upon all concerned.

* H.M. Stationery Office, 2s. 6d.

Newbury Relief Road Completed

LAST Monday, the Earl of Gosford opened a mile-long relief road for Newbury, Berkshire, running east and west. Built at a cost of £126,000, it is the first of two relief roads planned to end the serious delays now experienced in the Berkshire town. The second, not yet started, will run north and south. Newbury lies on the Bath Road, A.4, at the point where it is crossed by the Winchester-Oxford-Preston Trunk Road, A.34. In the centre of the town there is a short length of road called Oxford Street, which carries the traffic of both trunk roads and terminates in a small triangle where traffic has to go round a picturesque clock tower. There are sometimes queues 2 or 3 miles long during summer week-ends, when the volume of traffic reaches 15,000 vehicles per day. The east-west relief road will ease this situation by permitting traffic from London to the west to turn right before reaching the centre of Newbury. It passes to the north of the town and rejoins the existing Bath Road half a mile to the west of the clock tower. There are two roundabouts, one where the new road crosses A.34 and one where the projected north-south relief road joins it.

For the first 200 yards, dual carriageways have been built to carry the increased traffic when this part of the by-pass is included in the proposed north-south relief road. On the other part of the new road there is a 33ft single carriageway which corresponds to the carrying capacity of the Bath road generally. There are two footpaths. The road has a 6in gravel sub-base, on which has been laid a layer of lean concrete 1ft thick. Above this is a 2½in base course of bituminous macadam. When this has had time to settle, a 1½in surface course of hot rolled asphalt will be added. The road has been designed and the work supervised for the Ministry of Transport and Civil Aviation by the Berkshire County Council (county surveyor, Mr. K. P. Brow, M.B.E., M.I.C.E., M.I.Mun.E.). The contractors are Warings (Contractors), Ltd., of Portsmouth.

Air Conditioning of "Orcades"

THE Orient Liner "Orcades," of 28,000 gross tons, which was built at the Barrow works of Vickers-Armstrongs, Ltd., and sailed on her maiden voyage on December 14, 1948, has recently completed an extensive refit at the Belfast yard of Harland and Wolff, Ltd. As completed, the ship, described in our issues of December 17 and 24, 1948, had only certain public rooms and some inboard cabins fitted with air conditioning, but when she resumes her sailings in the Australian service every passenger and member of the crew will have air conditioned accommodation. Thermotank, Ltd., Glasgow, was responsible for the design, manufacture and installation of the new system which has a total refrigerating load of approximately 14,000,000 B.Th.U. per hour. A total of fifty-four air conditioning units, specially designed to fit the spaces occupied by the original heating and ventilating equipment, have been installed and these "made to measure" units have enabled the conversion to be carried out without loss of passenger space.

For air conditioning purposes the ship has been divided into a number of zones in each of which are sited automatic controls for temperature and humidity, while the volume of air to each cabin is under individual control by means of a simple adjustment of the distributor. Automatic control prevents build-up of air pressure when several louvres or distributors are closed. The total volume of cooled air supplied by the installation is 193,000 cubic feet per minute, equivalent to about 382 tons of air per hour,

and in maximum tropical conditions approximately 69 tons of water per day will be extracted from the air before circulation. In addition to the main air conditioning unit some fifteen air coolers serve the galleys and laundry. All fresh air inlets are fitted with Thermotank viscous pattern filters and for ventilating the refrigerating machinery space there are four new fans of 14,000 cubic feet per minute capacity.

Satellites and Rockets

THE Artificial Satellite Sub-Committee of the British National Committee on Space Research has prepared a Report on United Kingdom Observations of Artificial Earth Satellites and Associated Research, and it was presented at the second meeting of the I.C.S.U. Committee on Space Research (C.O.S.P.A.R.) at The Hague, March 12–14. This is merely a descriptive account, excluding details of the instruments and experiments and almost all of the results, and inconsistencies will be readily apparent to the technically qualified reader.

The second firing of a Saunders-Roe " Black Knight " research rocket took place at Woomera on Thursday last week. The vehicle reached an altitude of approximately 350 miles : this apogee is described as " several hundred miles " and the target area as being a " great distance " from the launching point.

Low-Temperature-Curing Anti-Friction Coatings

A LIMITATION on the use of polytetrafluoroethylene coatings for dry lubrication and parting purposes is the need to raise the surface to about 400 deg. Cent. to sinter the plastic into place. However, last autumn Acheson Industries, Inc., New York, placed on the market " Emralon " dispersions, which can be deposited on heat-sensitive materials, and two of the " Emralon " dispersions, 810 and 820, are now available from Acheson Colloids, Ltd., Prince Rock, Plymouth, Devon.* These coatings, having plastics binders, are claimed to adhere better than pure p.t.f.e., and even to be more resistant to corrosion.

" *Emralon* " 810, employing a phenolic binder, is applied by air spray and cured for one hour at 150 deg. Cent. : it will resist temperatures of 175 deg. Cent. continuously and 200 deg. Cent. for limited periods. It resists hydraulic fluids, oils and conventional solvents, but strong polar solvents such as ketones should be avoided. For maximum protection of steel a phosphate pre-treatment is recommended.

" *Emralon* " 820, containing a thermoplastic binder, can be applied by spraying or dipping and hardens in air at room temperature in two hours : it can be applied to metals, plastics and other rigid materials. It can be used in contact with weak solvents, and again phosphate pre-treatment of ferrous material is recommended.

Both dispersions are supplied as liquids of about unit density with a shelf life of two months. In each case the film formed has a friction coefficient of 0·05–0·07.

Structural Steel Fabrication in Canada

A NEW structural steel preparation aisle, the first of its kind in North America, is now in operation at the Dominion Bridge Company's recently completed structural shop at its Mount Dennis plant in North-western Toronto. Structural sections can be cut, drilled and cleaned in the preparation aisle in one continuous operation without intermediate handling. The aisle occupies 330ft by 60ft and is part of additional facilities now in operation at Mount Dennis, which occupy almost 200,000 square feet of floor space.

The system used is that introduced by Boulton and Paul Ltd., at Norwich, five years ago, and described in THE ENGINEER of June 19, 1953. It depends on a combination of four machines linked together by motorised conveyors and transfer skids and can handle I-beams, angles or column sections up to 70ft long, 30in wide or 16in high, with webs in a horizontal position. First in the line is a cold saw with a 44in or 48in diameter rotary cutting blade, supplied by Clifton and Baird, Ltd. After cutting, the beam moves across to a horizontal drilling machine which has two six-spindle drilling heads and drills holes in both flanges simultaneously. The next operation is drilling web holes. This is accomplished on an adjacent vertical drilling machine with a six-spindle head. Both these drilling machines were built by James Archdale and Co., Ltd. Finally, the beam is passed through a " Wheelabrator " shot-blasting machine of U.S. manufacture, which removes all rust and mill scale.

Layout and design of this unit was originated by Boulton and Paul, Ltd., in co-operation with the Dominion Bridge Company. The inclusion of blast-cleaning equipment is stated to be an innovation for this type of plant.

* " Emralon " is a registered trade mark of Acheson Industries, Inc., New York, registered user in the United Kingdom—Acheson Colloids Ltd.. It is manufactured under licence from E. I. Du Pont de Nemours and Co. under British Patent No. 804178. " Emralon " 810 is not licensed for use or for sale for use in providing electrical insulation.

Fertiliser Plant

HEAD WRIGHTSON STOCKTON FORGE, Ltd., has recently completed the construction of two dryers, four ball mills and two coolers as part of a plant for the production of fertilisers. The dryers, of parallel-flow, single-shell pattern, are 12ft in diameter by 90ft long and have a capacity of 180 tons per hour. They were built in three sections, connected on site by fitted bolts, and have two cast steel tyres mounted on machined cast steel chairs on the shell with girth rings of cast steel having machine-cut teeth. Cast iron labyrinth seals provided at the feed ends of the machines prevent ingress of air and leakage of material. Power is supplied by 300 h.p. squirrel-cage motors which drive through fluid couplings and totally enclosed helical reduction gear units and are connected to the main countershafts by flexible couplings. The cast steel bearing wheels run on Timken taper roller bearings on fixed spindles carried in heavy dead eyes on the fabricated bed-plates. Under certain circumstances the material being handled may become sticky so four pneumatically operated " knocker " units are provided near the feed ends to prevent accumulation of material, while radical lifters discharge oversize material through a central cone outlet. The ball mills are 7ft in diameter by 7ft long and each is driven by a 200 h.p. motor through a flexible coupling and gearing. The dimensions of the coolers, which are arranged for counter-flow working, are respectively 12ft diameter by 75ft long and 11ft diameter by 70ft long.

Careers in Agricultural Engineering

THE second " careers " lecture to be arranged by the Institution of British Agricultural Engineers was given in London on Thursday of last week, to an audience of sixty boys from public and grammar schools. The lecturer was Dr. P. C. J. Payne, of Wye College, Kent, who pointed out that agricultural engineering was not an industry that often got into the limelight, like the aircraft or motor industries. It had, however, possibly one of the strongest claims to fame in that it was truly wealth-creating. For example, Dr. Payne said, it was as true as a short generalised statement could be to say that the threshing machine—a British invention—was the forerunner of civilisation across the American Middle West. Whereas settlers previously had difficulty in providing a harvest big enough to see their families through a long winter, mechanised threshing enabled them to increase output sufficiently to realise the cash income so necessary for further advances. British agricultural engineering had always provided for the majority of the needs of this country's own farmers and since the war had quietly built up its export trade. In fact, Dr. Payne commented, in the list of exported manufactured goods, agricultural machinery in 1957 accounted for one-third of Britain's national credit in the balance of payments position with other countries. Thus, Dr. Payne continued, British agricultural engineering was already in a strong position. Moreover, the future was very promising provided that the brains were forthcoming to keep its research, design and productive capacity in the state of advance in which they were to-day. If the European Free Trade Area was introduced a great but highly competitive new market would be opened up immediately. In any case, the home market and that of the under-developed countries were expanding all the time.

James Forrest Lecture

THE Institution of Civil Engineers' annual James Forrest Lecture was given last Tuesday by Dr. W. H. Glanville, who spoke on roads and road usage, and the application of scientific methods to problems in road research. A similar theme had been expounded upon at a James Forrest Lecture thirty years ago, Dr. Glanville recalled, by the late Sir Henry Maybury. Dr. Glanville contrasted the situation then and now, and dwelt upon the numerous and dramatic improvements in all aspects—practical and theoretical—of the road situation since that time. He went on to review the economic gains from motor roads, especially urban ones, quoting as evidence not only statistics of road usage (for instance, that 25 per cent of the traffic is carried on 1 per cent of the road system), but also certain significant and prophetic opinions expressed thirty-five years ago by Hilaire Belloc in his book *The Road*. Research now in progress Dr. Glanville said, now included a " before and after " study for traffic on the London–Birmingham motorway. The " before " part of the study—an investigation of the volume of traffic (related to 1956) leaving London for Birmingham and certain other Midland centres, where the same route was used for part of the journey and of the time taken on these journeys—had been completed. From this estimates had been made of the traffic which would use the new motorway, and of the savings in journey time resulting from its use. An attempt was being made to assess these facts in monetary terms. A further, more general investigation aimed at studying the distribution of traffic in a certain area, and thence deducing the alignment of new roads which would best serve this traffic.

The ergonomic aspects of road usage were also reviewed by Dr. Glanville ; he instanced " Zebra " crossings and experiments with the " Maxaret " braking device. He also gave simple demonstrations to show the superior anti-skid properties of a rubber which has a high hysteresis loss when deformed. The subjects generally grouped by the Road Research Laboratory into the classification " materials and methods of construction," were also commented upon in some detail by Dr. Glanville. His lecture thus reviewed the whole field of road research, and as can be seen from the few examples noted here, picked out for critical comment a number of topics which are especially of interest to-day.

Aircraft Seat Reservations by Computer

TRANS-CANADA AIR LINES is to equip all T.C.A. booking offices across Canada with a seat-reservation device, or " Transactor," which sends information to and receives answers from a central computer. In the larger offices fifty or more " Transactors " may be installed. In operating the device, a pencil-marked card is inserted in the " Transactor " by the clerk requesting a reservation on a certain flight. The central computer determines whether or not space is available on the flight in question and the information is returned to the " Transactor," causing it to punch a hole in the edge of the card, providing the answer to the reservation request. The scheme had its origin in 1954, when T.C.A. consulted Ferranti-Packard Electric, Ltd., the wholly-owned Canadian subsidiary of Ferranti, Ltd., and requested the company to carry out design and development work. Ferranti-Packard, Ltd., has now received an order for equipment of this type to the value of 2,000,000 dollars. The system will be made available in the United Kingdom and the Continent by the parent company, Ferranti, Ltd., Hollinwood, Lancs.

Sewer Diversion at Hyde Park Corner

PART of the L.C.C's Hyde Park Corner improvement scheme involves the construction of two vehicular underpasses to take traffic between Piccadilly and Knightsbridge. As a preliminary to this construction, it has been necessary to divert part of the King's Scholars' Pond relief sewer which is 8ft by 6ft 4in in size (internally) and constructed in 9in brickwork. A length of approximately 1200ft is being abandoned and replaced by a new 6ft 6in internal diameter sewer, built in tunnel.

The diversion commences in Piccadilly at a new manhole some twenty-five yards east of the Wellington Memorial ; following a route parallel with and on the north side of the northern underpass, it crosses diagonally under the carriageway opposite Apsley House and passes under the central entrance of the Decimus Burton Screen (Apsley Gate). Thence under Hyde Park, turning in a south-westerly direction, it passes under the western open approach and forms a junction with the existing sewer at a new manhole some twenty yards west of Old Barrack Yard, Knightsbridge. The whole of the tunnelling has now been completed and the lining of the tunnel in brickwork and concrete is in progress.

For the tunnelling, a working shaft 11ft square was excavated and sunk on the site of the intermediate manhole. After preliminary work had been carried out at the foot of the shaft and sufficient lengths of tunnel had been built in both directions to accommodate tracks for skips, regular daily twelve-hour shifts were started, the rate of progress being five rings per shift. The upstream tunnel, working towards the manhole in Piccadilly, was driven in good blue London clay. The downstream tunnel, working towards the manhole in Knightsbridge, encountered water-bearing ground 100ft from the centre of the working shaft. Efforts were made to continue tunnelling operations in free air but progress was reduced to one-and-a-half rings per shift. At this stage compressed air was used.

The air pressure varied between 5 lb and 10 lb per square inch. Night and day shifts were worked for a five-day week, and the progress improved to five rings per shift. As the tunnel approached the King's Scholars' Pond relief sewer the air pressure was gradually reduced to 3 lb, and as soon as the brickwork of the existing sewer was reached, was discontinued. Towards the end of the drive, the ground, consisting of a face of damp sandy brown clay, improved. The 30ft radius curved junction was built in free air.

The tunnel is lined with precast reinforced concrete segmental rings 8ft 3in external diameter and 7ft 3in interior diameter by 2ft long for a finished diameter of 6ft 6in. The segments are made of 1 : 1½ : 3 concrete using high alumina cement. All bolt holes are 1¼in diameter to take ¾in diameter bolts and holes formed in the skin of each segment for grouting behind the segments are 2in diameter. A ring consists of three ordinary segments and two top segments ; the key, which is solid, is 3⅜in thick. A rebate 1in by ¼in is provided in the circumferential and longitudinal joints of the segments for either pointing in cement mortar in dry ground, or caulking with " Philplug " if the ground is wet. Average crushing strengths of 9860 lb per square inch after seven days have been measured at the casting yard. The rings are built so that each complete ring breaks joint with the adjacent ring, and the keys of alternative rings are in central position.

The lower third of the sewer is lined with one ring of Southwater facing bricks. The bricks are bedded on 1 : 1½ : 2½ concrete lining, the nominal thickness of concrete between the underside of the brick ring at the invert and the flanges of the segments being 2in. The remaining two-thirds of the sewer is lined with 1 : 1½ : 2½ concrete, placed by hand, and vibrated against a curved top shutter. Progress is being maintained at the rate of three 12ft lengths per shift of twelve hours.

Before breaking into the relief sewer to construct the 30ft radius curved junctions at the Piccadilly and Knightsbridge ends of the diversion, temporary by-passes were constructed to contain the flow, consisting of precast concrete segments giving a diameter of 4ft 6in. Both by-passes were built in tunnel after the first stages of excavation for the manholes had been completed. On completion of the diverted length of sewer the by-passes will be filled solid with 1 : 12 concrete, and so will the abandoned length of sewer, including two manholes, but excepting the lengths which will be cut out during the excavation for the underpasses.

The works are being carried out under the direction of the L.C.C's chief engineer, Mr. J. Rawlinson. The contractor is W. and C. French, Ltd.

Visual Transmission of Train Information

A TRIAL installation of the " Deccafax " visual communication system is being operated at King's Cross Station, London, by the Great Northern Line of the Eastern Region British Railways, in conjunction with Decca Radar, Ltd., Albert Embankment, London, S.E.11, manufacturer of the " Deccafax " system. The equipment is being used for passing train information from the signalbox to various sites in the station which require the information for passing

Arrival indicator operator at King's Cross receiving train information transmitted visually from the signalbox

to the public. This trial system is intended to reduce telephoning by providing visual information at several positions simultaneously. Arrival details of main line trains travelling to London are received in the signalbox from Peterborough, Hitchin and Hatfield, and hitherto have been passed by telephone to the various station officials who need to receive them (e.g. the station announcer, and the operators of the train arrival indicator board). Using the " Deccafax " system this information is passed visually to the receiving points.

The equipment under trial consists of a transmitter in the signalbox, and receivers located in the station announcer's office, the train arrival indicator board, the inquiry office and the yard inspector's office. Messages for transmission are written either on a transparent surface over the face of the transmitting tube, or on a prepared transparent proforma. They are scanned by a flying spot system and reproduced at the receiving points continuously ; a bell is rung from the transmitter position whenever a fresh message is sent.

For the purpose of the present trial—at any rate at the outset—messages are being transmitted in a stereotyped form. This permits the use of transparencies which have been pre-printed, leaving only the details of the message to be filled in by hand.

Electrification of the Kent Coast Lines

WORK on the first phase of the Kent Coast electrification scheme on the Southern Region of British Railways began some three years ago, and when it is completed in June next, at a cost of £25,000,000, seventy-eight route-miles of newly-electrified track will be put into service. An outline of this project was given on page 10 in our issue of January 2, 1959, and the Southern Region recently organised a press visit to show the progress of the scheme, which is fully up to the planned schedule.

Under this first phase a completely electrified system will be introduced on the main line from Victoria to Ramsgate and Dover and the Sheerness branch route. Under the second phase, which is scheduled for completion by June, 1962, the remaining routes in Kent to be electrified will include Sevenoaks-Dover, Ashford-Ramsgate, Maidstone East-Ashford, Paddock Wood-Maidstone West, and Ashford-Ore. This will entail the electrification of 157 route-miles and will cost, including the rolling stock, a further £20,000,000.

For this second phase the only two stretches of track where extensive earthworks are contemplated are between Folkestone Central and Cheriton, where the lines are being quadrupled, and between Ashford and Pluckley, where one additional line will be built. Platforms are being extended at Folkestone Junction and other stations to take the twelve-car express trains, or at smaller stations the eight-car intermediate trains. Folkestone Central station is being reconstructed with two island platforms to provide access to the four lines. At Ashford the marshalling yards will be modernised and the passenger station rebuilt. Down and up loop lines are to be provided, where there will be big carriage inspection and repair sheds for the new electric trains.

A majority of the rolling stock for the new electrified lines has been built and the express routes will be served by four-car trains similar to those recently introduced on the Brighton line. From June next, when the first phase is completed, it is planned to run on the hourly services from Victoria to Ramsgate and Dover twelve-car trains of three units. These expresses will be split at Gillingham—the leading portion travelling on to Ramsgate and the second portion to Dover. For these express services fifty-three four-car units will be used, and on the intermediate services completed under the programme sixty-two two-car units of the type now used for the Sevenoaks trains will be used.

In addition to the new passenger trains, twenty-four electric locomotives, similar to the one described in our issue of Febuary 13 last, page 267, will be used to haul freight and certain passenger trains. There are also to be introduced ninety-eight diesel locomotives, mainly for freight services on the Kent Coast and Hastings lines.

Transatlantic Telephone Cable Orders

THE first of two orders for a total of 2152 miles of submarine cable for the Scotland–Newfoundland link, at a cost of £3,000,000, was issued last week to Submarine Cables, Ltd., of London by Cable and Wireless, Ltd. The cable will be made at the Telcon Works, Greenwich, of Submarine Cables, Ltd., (owned jointly by Siemens Edison Swan, Ltd., and the Telegraph Construction and Maintenance Company, Ltd.), and will be laid in the summer of 1961. It will be the first ocean link in the 30,000-mile Commonwealth round-the-world telephone cable, estimated to cost £88,000,000.

The initial order is for 552 miles of armoured cable for the shallow water sections and shore-ends at a cost of £745,115, and is expected to be followed shortly by an order for 1600 miles of lightweight cable at a cost of £2,254,400 for the deep-sea section. The lightweight cable is of a new type, specially developed for use with rigid, two-way submerged repeaters of British design. About ninety-two repeaters will be required for the transatlantic section. An order for their

manufacture will be placed by Cable and Wireless, Ltd., later. The transatlantic section, estimated to cost £9,000,000, is being jointly financed by the company and the Canadian Overseas Telecommunication Corporation.

The single cable will provide capacity for sixty simultaneous telephone conversations, or some forty-eight telegrams in place of any one of them. This compares with thirty-five telephony channels in the present double cable, laid in 1956, each able to accommodate eleven telegraphy channels. The existing cables are each equipped with one-way American type repeaters, and the link is under joint Anglo-American-Canadian ownership.

Position of British Shipbuilding

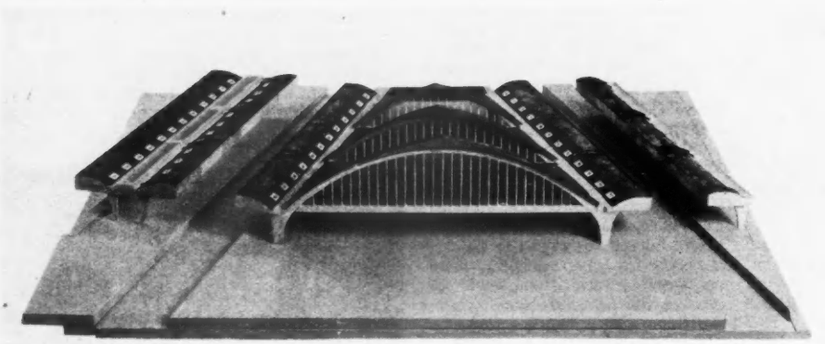
SPEAKING after the launch of the 42,000-ton tanker "British Destiny," from the Wallsend yard of Swan, Hunter and Wigham Richardson, Ltd., Mr. E. J. Hunter, the chairman of the builders, said that the ship was another example of the pre-eminence of Great Britain in shipbuilding. He deplored the inference that because we occupied third place amongst the world's shipbuilders, on the basis of gross tonnage, the industry was in a decline. On the contrary, our output had not sunk but had remained static while that of Germany and Japan, stimulated by exceptional demands, had increased. Comparisons made on the basis of gross tonnage, he continued, were misleading since they took no account of the class of tonnage being built, there being a considerable difference between the amount of work represented by oil tankers compared with that involved in the construction of passenger liners and naval ships, which were not being built in Germany and Japan. As an example of this, he instanced the 28,000 tons of the "British Destiny" and 18,700 tons of the passenger liner "Bergensfiord," which in value represented twice that of the oil tanker and involved practically three times as much work. Taking these factors into consideration, he doubted whether the overall output of Germany or Japan exceeded that of this country. Although the position gave no grounds for complacency, he maintained that the British shipbuilding industry was efficient and was becoming more so, and that in criticising those who worked in shipbuilding it was well to remember that they were human beings with human failings.

Liverpool Steam Ship Owners' Association

THE Annual Report for 1958 issued by the Liverpool Steam Ship Owners' Association records that the gross tonnage entered in the Association, at the beginning of 1959, was 4,568,049 tons. Imports at 104·2 million tons were nearly the same as 1957 but the total cost of £3801 million, was 6·7 per cent less and represented the fall in commodity prices, while the tonnage employed amounted to 79,865,000 tons net, of which 52·3 per cent was British. The estimated weight of exports, other than coal, given in the report is 24,247,000 tons, the value, including 5,763,000 tons of coal, being £3356 million, while the shipping involved was 51,392,000 tons net, of which the percentage British was 63. Although overall imports were practically unchanged, there were changes in component items and the report notes that raw materials dropped by 17 per cent, an unsatisfactory trend since the level of imports required for our export trade must be maintained if those earmarked for home consumption are to be maintained. The weight of exports indicated a 5 per cent increase over last year but the value was 3 per cent less. When "invisible" exports earned by various services are added to export sales, which equalled 88 per cent of the value of imports, a credit balance results and the report considers the year to have been satisfactory. Although British ships slightly improved their share of the export trade, their share in the import trade decreased to continue the trend of the last decade, and the report goes on to comment on discriminatory practices which divert cargo to national flag fleets regardless of economic considerations. The result, it is considered, will produce economic chaos in marine transport, the price of which will be a charge upon producers and consumers for neither ships nor ports will function efficiently under the restraints imposed by artificial controls designed to benefit particular nations. Such practices result in the production of tonnage in excess of requirements, thus reducing ships' earnings to be matched by increased subsidies and the report feels that the continued growth of such a position is a threat to the existence of all shipping operating on an economic basis.

Oxford Road Station, Manchester

As part of the British Railways' programme of modernisation, the Oxford Road station in Manchester is being rebuilt almost entirely in timber. The station will consist of a roofed concourse and five platforms as shown in the illustration. The concourse is on a tapering site



Model of conoidal shell roofs of the new station

fixed by the position of the existing platforms, and conoidal shells were chosen for the roof structure chiefly because this form of construction is suitable for a triangular site. Other requirements are uninterrupted floor space and good natural lighting. Timber shells were chosen partly in order to reduce foundation loads. British Railways prepared the design for the new station with the assistance of the Timber Development Association.

The concourse is roofed with three conoids spanning from 97ft 3in maximum to 41ft 6in minimum. The shells are supported on glued laminated timber arches and ties which are being prefabricated and transported to the site in two sections. An exception is the rear edge frame which is being prefabricated in one unit. The shells, which are being constructed on site, are made up of three layers of tongued and grooved boarding nailed and glued. The shells are cantilevered forward partly in order to preserve structural balance and partly to prevent glare. The inside will be weatherproofed using the "Evode" process and finishing with aluminium spray.

The five platform canopies are formed by cylindrical timber shells, cantilevering 12ft and spanning 34ft 10in, supported on glued laminated timber bents. They have been prefabricated in 34ft sections in the workshops of Tinker and Young, Ltd., the contractor for the entire timber structure. The upper edge beam of the shell, which is covered with tongued and grooved boarding laid diagonally, forms the valance running along the outside edge. The rear edge beam and the guttering are in plywood. There are small openings in the shell for natural lighting.

The north lights on the canopies and the openings in the canopies will be glazed with glass-fibre-reinforced plastics. The timber used throughout is Western hemlock. The work has had to be timed to avoid major disruption of train services. At present, nearly all the platform canopies are in position and the first of the conoids is being boarded.

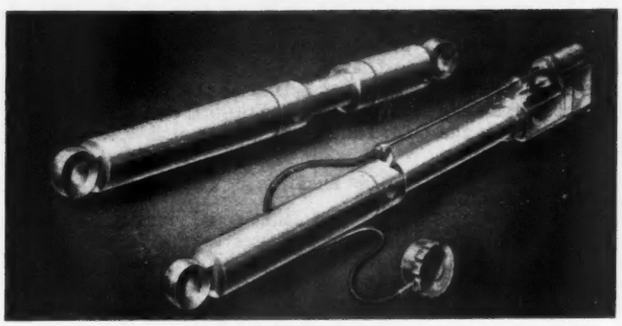
Marine Engineers' Annual Dinner

MR. E. L. DENNY, the president, was in the chair at the fifty-sixth annual dinner of The Institute of Marine Engineers, which was held at Grosvenor House, London, on Friday, March 13, and was attended by some 1300 members and their guests. In proposing the toast of "The Royal and Merchant Navies," Sir William Wallace, the president-elect, regretted the passing of the Navy and the reduction in the comparative size of the merchant fleet. Nevertheless, he felt that they were still strong in men and materials and commented that with 2 per cent of the world population Britain exported about one-fifth of the world's manufactured goods. Sir Nicholas Cayzer, Bt., replied, and said that the association of the Royal and Merchant Navies went back a long way and that at the time of the Armada, when the fleet was as much Merchant as Royal, a voyage to the Spanish Main was much more remunerative than now. There continued to be close contact between the two navies, for the country could not afford to underrate our enemies as it had done in the past. The nation must realise, he continued, the problems facing the merchant navy, especially the triple threat of flags of convenience, subsidies and flag discrimination, all of which loaded the dice against it. It was a situation to be solved in conjunction with the Government, it was indeed a national problem, and Sir Nicholas emphasised that since four-fifths of the raw material and half of the food supplies had to be imported the position was more than just the survival of an industry but of the nation, and all must fully realise present perils. Lord Geddes gave the toast of "The Institute of Marine Engineers," and thought that in making efficiency the target of the industry it was easy to overlook the capital cost involved in achieving sometimes quite small increases. He made a plea for the simplification of installations, and supported the idea of a "throwing-out" committee. The president responded and commented that to-day many decisions were dictated by fashion rather than on a technical basis. He went on to say although fixed specifications were helpful he thought that engine builders should be allowed to put forward their own proposals.

Hydraulic or Pneumatic Actuators

AN actuator for positional control, and designed for hydraulic or pneumatic operation, which has been developed by the aircraft division of the Turner Manufacturing Company, Ltd., from the original Leduc designs (November 1, 1957, page 632), is now being marketed through a subsidiary company, Hydraulics and Pneumatics, Ltd., Villiers Street, Wolverhampton. These actuators are made in a number of models arranged for either manual or solenoid control. The non-servo unit is of single cylinder construction incorporating its control means within the cylinder either for manual operation or for electric operation. Its installation is simple, requiring separate pipes to power supply and to exhaust. The

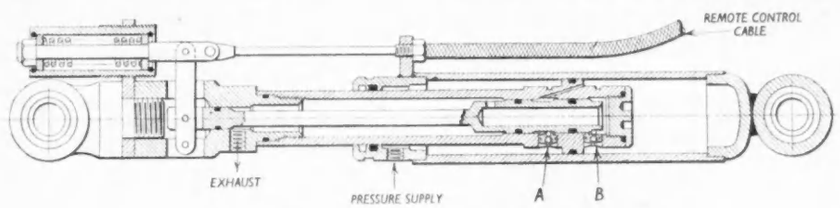
control is by mechanical means, such as a cable, or alternatively by solenoid as part of the actuator. In the servo-actuator a valve is incorporated within the cylinder assembly with its operating means and positive locking is provided. The valves can be so adjusted that extension of the piston rod to any reasonable limit can be achieved at the time of manufacture.



Servo-actuator for positional control (below) and non-servo actuator with built-in solenoid

Typical actuators of the new design can be seen in the photograph we reproduce and the capacities of the various models are given in the table below.

The construction and method of operation of the actuators can be seen in the drawing we reproduce of a typical servo model used for positional control. In this unit the supply of pressure fluid is connected to the rear or left-hand end of the cylinder, and the effective annular area on the rear end of the piston is half of that on the head, or right-hand end.



Construction of servo-actuator for positional control

A ball valve *A* is fitted in the back end of the piston, and when it is opened from the control gear by a bored central control rod it allows pressure fluid to flow from the rear end of the cylinder, through channels in the piston head, to the upper end of the cylinder. A second ball valve *B*, also actuated by the control rod, connects the upper end of the cylinder to exhaust. When the control rod is stationary the two ball valves register in recesses in the rod and their orifices are sealed.

If the control rod is moved outwards the ball valve *A* is depressed to open its orifice and allow fluid to flow into the front end of the cylinder to increase the pressure on the head of the piston to a value which will balance the external load. In this operation the fluid pressure moves the piston in the same direction as the valve rod and it comes to rest when movement of the rod ceases and the ball valve again closes. When the control rod is moved inwards it opens ball valve *B* which allows the pressure of the fluid in the head of the cylinder to fall to a value which will differentially balance the external load. As before, there is a follow-up movement of the piston by which valve *B* is closed when movement of the control rod ceases. Between the opening of the valve in one direction of movement and the opening of the valve in the opposite direction the valve rod moves a predetermined distance during which the piston is not active. This inactive period or lost motion can be regulated to suit requirements by varying the diameter of the balls used in the valves.

A non-servo actuator with a built-in solenoid can be seen above the servo model in the illustration and this design is intended for use in a conventional ram/solenoid valve installation.

This firm has also introduced a new automatic variable delivery constant pressure pump, which by means of a simple hand control can be set to deliver oil at any pressure from 500 lb to 2500 lb per square inch.

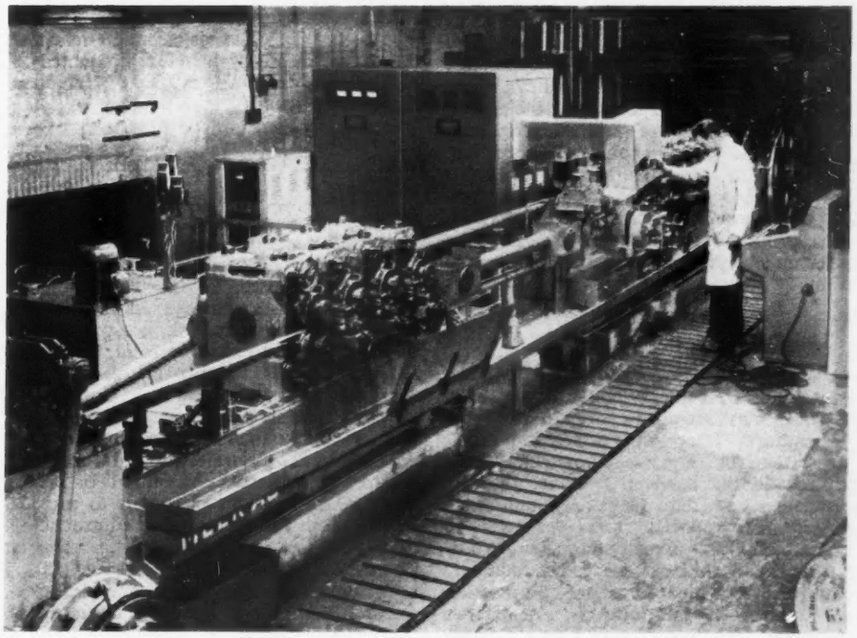
	Bore, in	Stroke, in	Effective ram area, sq. in	Max. working pressure, lb per sq. in	Max. thrust, lb
Hydraulic models	1½	6 & 12	0·88	3,000	2,640
	3	6 & 12	3·6	3,000	10,800
	6	12	14·2	2,000	28,400
Pneumatic models	2	6 & 12	1·57	400	628
	4	6 & 12	6·3	200	1,260
	6	12	14·2	200	2,840

Welded Aluminium Tubes

A PLANT for the manufacture of aluminium tubing by a continuous high-speed process from coiled strip has been installed at the works of Elm Engineering, Ltd., Southern Road, Aylesbury, Bucks. The plant, the first of its kind in this country, is based upon a high-frequency resistance welding process developed by the New Rochelle Tool Corporation, of New York. It is designed for making tubes from ½in to 1½in outside diameter and with wall thicknesses from 14 to 22 gauge, at speeds from 400ft per minute with light gauge strip to 110ft per minute with the heaviest gauge. As the process is continuous tubes can be made economically and to any reasonable length required.

The general layout of the plant can be seen in the illustration on this page. Aluminium strip is drawn from a coil at one end of the machine and formed into a tube in passing through eight stands of driven forming rolls. At the welding station two copper base alloy contact shoes rub against the sides of the tube just before the edges of the open seam are pressed together. These shoes are used to transmit high-frequency current (at 450,000 c/s) along either side of the seam. Actual heating of the material to a temperature of about 1000 deg. Fah. occurs for a very brief period and only on the edges as they are forced together by two horizontal pressure rollers to form a forged weld. The depth of metal heated is only a few thousandths of an inch and much of it is displaced by the roller pressure to form a ridge, or scarf, on each side of the weld. This, it is stated, ensures that the crystal structure of almost all the parent metal on the tube is unaffected by the welding process.

The weld ridge on the outside of the tubing is sheared off immediately after leaving the welding station as the tube passes under two carbide-tipped form cutting tools. From a cooling trough the tubing is then carried through stands of sizing and straightening rolls. A flying guillotine at the end of the machine line can be set to cut the tubing to any required length as it passes to a run-out trough.



Plant for making aluminium tubes from strip by a high-frequency welding process

Ball Mills

THE latest ball mills available from Apex Construction, Ltd., 15, Soho Square, London, W.1, employ a fresh principle. Instead of the container of the work and the balls being rotated to cause the balls to cascade, the container executes, without rotating, a planetary motion : thus, the balls are constrained to move around the container. This is achieved by mounting the container on C-springs and exciting it by an out-of-balance rotor running in a plane parallel to that of the springs. It is claimed that pulverisation down to particle sizes of 1 micron can be attained by this machine with such a narrow size distribution that screening or air sizing can be eliminated. With balls of porcelain or non-corrodible steel, grinding of tungsten carbide, graphite and materials for ceramic and powder metallurgical purposes has been carried out.

Industrial and Labour Notes

Iron and Steel

The Iron and Steel Board's monthly report says that in February pig iron production in Great Britain averaged 221,800 tons a week and was thus at an annual rate of 11,536,000 tons, compared with an annual rate of 14,182,000 tons in February, 1958. The output of steel ingots and castings in February averaged 349,000 tons a week, representing an annual rate of 18,146,000 tons, compared with 22,228,000 tons in February last year. Steel output last month, the report explains, was hindered to some extent by a strike in the works of one of the main producers, and by some mechanical difficulties.

The report includes some information about steel stocks at the end of last year. It is estimated that merchants' and consumers' stocks declined by 487,000 ingot tons in the fourth quarter of 1958, compared with a fall of 368,000 ingot tons in the third quarter. Steel stocks have fallen in the public sector, and in the private sector, shipbuilding, building and constructional engineering, and the industries manufacturing components, such as bolts, nuts and screws, have continued to show the heaviest fall in stocks. In the final quarter of last year, however, the motor vehicle building industry also began to run down its steel stocks. But stocks of steel held by consumer goods industries, such as metal furniture, hollow ware and wire drawing, have been maintained.

An announcement about the new strip mill which is to be built by Richard Thomas and Baldwins, Ltd., near Newport, Mon, was made last week by the Minister of Power, Lord Mills. He said that the Government had agreed, in principle, to lend the firm up to a maximum of £60,000,000 towards the construction of an integrated steel works, including a semi-continuous hot strip mill. It is hoped that construction work on this project near Newport will begin this summer and the plant should come into operation during 1963. It should have a " significant output " in 1964 and reach full production in 1965 or 1966, by which time its capacity should be about 1,000,000 tons of steel ingots a year. It is intended that, when the plant is complete, its output should include at least 600,000 tons of finished strip mill products and that it should also meet any deficiency in steel requirements at Ebbw Vale. At Redbourn, Lincs, steel from which will no longer have to be sent to Ebbw Vale, it is proposed to construct a continuous billet mill to process the output of the new plant.

Training Foremen

Two new films produced by Merton Park Studios for the British Iron and Steel Federation are intended mainly to assist the training of foremen. It is clearly important, the Federation says, that foremen should understand the financial structure of their companies, so that they fully appreciate management policies and decisions in financial matters. Equally they should know the system on which departmental production costs are calculated since the co-operation of foremen in this field is essential to efficiency. The first of these films, " Money and Steel," illustrates the capital structure of an imaginary, integrated steel works of 1,000,000 tons capacity, and explains how the capital of the company is tied up in fixed and current assets. Animated diagrams are used to show how the company's income pays for raw materials, wages and salaries, services and other expenses, and how the final trading surplus is allocated to taxation, dividends and reserves. The way in which fresh capital and reserves are utilised to pay for development and expansion is also explained. The film runs for nine and a half minutes.

The second film, entitled " Counting the Cost," explains how delays in production caused by breakdowns, mishaps or carelessness affect production costs. The fluctuations of daily production are shown against the target line of standard working. The cause of some of the black spots, when production falls steeply, is examined, and it is shown how a cobble in the mill or an electrical failure in a crane can start a chain of events bringing production to a standstill. The film goes on to explain what this standstill means in terms of idle time, loss of yield and extra heating costs, as well as the fall in output and the cost of repairs. This film runs for ten and a half minutes. Both films are obtainable in either 16mm or 35mm on free loan from the Federation's film library, Steel House, Tothill Street, London, S.W.1.

Overseas Trade

The provisional figures relating to the United Kingdom's overseas trade in February show that the value of exports was £250,900,000. This was £19,000,000 lower than in January and if the figures for the two months are considered together, they indicate that, in value, exports were 3 per cent lower than in January and February last year. Imports in February showed the customary seasonal decline, their value being £292,400,000, which was £36,000,000 below the January figure. Taking January and February together, however, the value of imports was 1½ per cent higher than a year earlier. Re-exports in February were valued at £10,400,000. The visible trade deficit at the end of February therefore amounted to £31,100,000, which was £18,000,000 less than the January figure.

British Exhibition in New York

Plans are now taking shape for the holding of an all-British exhibition in the Coliseum Building, New York City, from June 10 to 26, 1960. This exhibition, which is being organised by the Federation of British Industries through its subsidiary, British Overseas Fairs, Ltd., is supported by the United Kingdom Government, the Dollar Exports Council and the British-American Chamber of Commerce in New York. The Government's support of the exhibition, it is stated, will take the form of a special display designed by the Central Office of Information on lines determined by the Board of Trade. The intention of this display is to provide both a physical and thematic introducton to the rest of the exhibition, its primary purpose being to demonstrate Britain's front-rank position in scientific and technical research, the fruits of which will be shown by the industrial products in the trade sections of the exhibition. The Government's display will also seek, it is announced, to attract visitors by indicating some of the " links of background, usage and outlook which bind the United Kingdom and the U.S.A. together."

Further details of this exhibition can be obtained from British Overseas Fairs, Ltd., 21, Tothill Street, London, S.W.1.

New Industries in Unemployment Areas

The Ministry of Housing and Local Government states that it is prepared to consider making a grant towards the cost of water and sewerage services needed for a " substantial new industrial development " in those parts of the development areas where there is high unemployment. Local authorities must, of course, be able to show that they cannot reasonably meet the full cost of these services from their own resources. The Ministry is also prepared to consider applications from local authorities in the same areas for help towards improving the standard of their water and sewerage services.

It is stated that these grants would be paid under the powers of the Distribution of Industry Act, 1945. Grants under this Act for water and sewerage schemes in development areas were stopped in 1952 as an economy measure, although it was stated subsequently that consideration would be given to assisting schemes required on grounds of exceptional industrial urgency.

The Ministry's circular, which details these new arrangements, refers also to a recent announcement that the Board of Trade is now prepared to consider making grants under the Distribution of Industry Act of up to 75 per cent of the approved cost of reclaiming derelict land in development areas. The provision is that the work must be completed by March 31, 1960.

South Wales Docks Modernisation

The British Transport Commission has announced this week improvement and modernisation schemes, estimated to cost £1,125,000, at the South Wales ports, which include Newport, Cardiff, Penarth, Barry, Port Talbot and Swansea. A programme of modernisation is to be carried out at No. 4 Quay, King's Dock, Swansea, and two diesel-engined hopper dredgers (a triple-grab and a twin-grab) are to be ordered to replace three obsolescent steam dredgers.

The scheme for modernising the No. 4 Quay at King's Dock, Swansea, includes the provision of nine new electric cranes with a radius of 70ft, the renewal of the crane track, the repaving of the quay flush in concrete, and additional railway facilities. The new cranes, which will replace obsolete hydraulic appliances of lower capacity, will comprise four units of 10 tons capacity for the discharge of bulk dry cargoes by grab, and five of 7½/4 tons capacity, which will be used for the dual purpose of loading and discharging general cargoes and discharging bulk dry cargoes. The electrification of the cranage on this quay will reduce the extensive hydraulic system at Swansea, which will be further curtailed by the closing of the three existing hydraulic power stations and their replacement by five electric pumping stations located close to the appliances they will serve. Long stretches of hydraulic pipes radiating from the present power stations will thus be eliminated.

Advantages of Prestressed Concrete

AT a lecture before the Prestressed Concrete Development Group, given in London on March 4, Professor H. Rüsch, of Munich Technical University, spoke to the theme "How can the advantages of prestressed concrete best be utilised?" After referring to the early invention of prestressed concrete—a patent for making prestressed concrete planks 2in thick dates back to 1888—the lecturer described the slow progress during the early years of this century when prestressing was suggested as a means for preventing hair cracks in concrete. When it was realised that such cracks did not lead to corrosion of the reinforcement, the proposal was quickly forgotten. It was not until the 1930s, due mainly to the work of Freyssinet, that one of the main advantages of prestressing came to be realised, which was the saving of reinforcement steel. The ingenious pioneer work of Freyssinet created what amounted to a fashion which lasted until about 1950. Prestressing had been applied somewhat indiscriminately and there took place a certain reaction against it.

Besides avoiding cracks and saving steel, prestressing also led to a saving in weight, a major advantage in the case of large spans.

Initially, calculations for prestressed concrete had been made on the basis of permissible stresses. The prestress produced an additional state of stress which counteracted the stresses produced by the load, and it was therefore reasonable to assume that the actual stresses would thereby be reduced. However, it was shown later that it was not possible to calculate a prestressed concrete structure if only the stresses produced under the normal load were taken into account, because this meant reducing the factor of safety. It was now known that a prestressed structure had lower stresses under the normal load, but that in most cases prestressing could not contribute to any great extent to the failure load which the structure could withstand. The reduction of the weight did not come from the reduction of the section of concrete subjected to compression.

The sectional area needed to contain the steel, however, while still maintaining the necessary concrete cover, was much less for prestressed concrete because of the increased stress in the steel. Thus, for instance, in a bridge of large span a much thinner web could be used for the beams. Moreover, whilst with reinforced concrete in many cases a thicker web had to be used because of the shear stresses, in prestressed concrete these stresses were reduced considerably.

Further scope was given by the use of concretes of higher strength, which were normally used for prestressed concrete, but these could, of course, be used also for ordinary reinforced concrete structures. Another advantage of prestressed concrete was that it could be used in tension. There were many cases where tension in concrete structures could not be avoided, as with tie-beams, or with cylindrical or doubly curved containers. This meant that the stress in the concrete must be below the tensile strength of the concrete, which, in plain concrete, was approximately one-tenth of the compressive strength. If one prestressed such a structure one could induce a very high compression stress, up to perhaps four-tenths of the compressive strength of the concrete. Thus, the live load had to overcome this compressive stress as well as the tensile strength of the concrete before cracks would occur. The thickness of such a wall could be reduced to about one-fifth of that necessary for a reinforced concrete structure.

In a cylindrical tank which had been prestressed to counteract the influence of the load, there were ring stresses as well as a heavy compression stress when the container was empty, which changed to a small tensile stress when the container was full. It was necessary to determine that distribution of the prestress which led to the minimum bending moments. The easiest way to apply the prestress to such a container was to wind round it continuous wire under a certain stress. This had the disadvantage, however, that all the wire was on the outside of the wall. This reinforcement needed to be protected against corrosion, and a thin layer of gunite was normally used which was not prestressed. As the container was being filled, a heavy tensile stress appeared in this layer which could lead to cracking and corrosion. Moreover, the centre of gravity of the reinforcement should normally coincide with the centre of gravity of the concrete, which was not the case here. If cracks occurred, they could open wider than if the steel were central and fully bonded with the concrete. Many attempts had been made to put the prestressing wire inside, but this was difficult. A heavy anchoring wire had to be used and there was a reduction in the prestress due to friction. It was necessary to use four wires or bars to cover the whole circumference of the container. The German firm of Dyckerhoff and Widmann had built a series of containers about 120ft high for a sewage plant which were constructed in sections and prestressed independently. This avoided the cost of extra ribs for anchoring the prestressing steel (except one at the starting point) and also permitted scaffolding and formwork to be used several times over. Scaffolding could also be economised by building at ground level and raising the finished structure on jacks, as was done in the case of the fully prestressed water tower at Orebro, Sweden. (August 9, 1957, page 208.)

Prestressed concrete, said Professor Rüsch, could be used to advantage where it was not possible to calculate accurately the stresses which would occur in use. He once had to design a large salt store from which the salt was to be extracted by dissolving it in hot water. It was impossible to calculate the local temperature stresses, and in such a case a material was needed which had approximately the same strength in tension as in compression, such as steel or timber. On the other hand, concrete would withstand the very corrosive conditions. It was found possible to use concrete by prestressing in two directions. This produced a homogeneous state of compressive stress in the slab, which amounted to an increase in the tensile strength. Almost any tensile strength required could be produced in this way.

On many occasions, e.g. in the case of a railway sleeper, one did not know whether the moments would be positive or negative. Prestressing would then be the best solution, because it was applied more or less centrally, so that the sleeper could then take approximately the same positive or negative moment. The high weight of such sleepers, resisting lateral displacement, was a technical advantage in connection with very long continuous rails.

A further possibility was to induce in a beam moments opposite in sign to those produced by the anticipated load. This made it possible to reduce to a large extent the deformations of the structure. A notable example was a very large continuous rolling mill foundation about 110ft long, 80ft wide and 13ft thick and weighing some 10,000 tons. In order to compensate for mining subsidence, which could be anything from 3ft to 10ft, the structure rested on three large, separate foundations on which were placed hydraulic jacks. By means of the jacks the level could be adjusted accurately, if necessary from minute to minute. Prestressing was used as being the best method to avoid deformation even under the influence of creep.

A further advantage of prestressing was that it could be used to counteract stresses produced by loads in such a way that the statical system of a structure was completely altered. This method had not yet been used enough for its scope to be fully appreciated, but it offered very many possibilities. An example of the application of this idea was a skew bridge. A prestressing cable in the form of a parabola would take the dead load of the bridge. Instead of a very complicated distribution of bending moments to be allowed for, the solution became very simple, since the structure was statically determinate.

Another example was the frame of an industrial building with a relatively large span in which the beams had to carry a very heavy load. Slender beams were wanted and so they had prestressed them, but they did not wish to prestress the columns as well because of the complication and cost. Therefore, they had tried prestressing the beams in such a way that the prestress moment counteracted the moments produced by the load in the columns, thus avoiding tensile stresses in the columns.

It was also possible to construct a box girder bridge using precast units. Beams which were at first freely supported might later be stressed into continuous girders.

Prestressing could also be used to avoid stresses which arose in shell structures near the

Prestressed concrete bridge of 400ft span over the River Moselle at Coblenz. Construction by cantilevering in 10ft long sections. The prestress is adjusted according to the state of construction

edges, owing to the conditions of compatibility. For example, in a dome in which the horizontal thrust was taken by a ring beam, the membrane state of stress in the shell produced a compression in the direction of the ring, which meant that the diameter of the dome decreased slightly. Under the influence of the horizontal thrust, however, the diameter of the ring increased. Thus, for compatibility, the shell must be deformed, causing bending moments in it. These could be avoided by prestressing the ring beam so as to produce in it just the same compressive stress as appeared in the membrane. This was a possibility which could well be exploited in the design of shell structures, resulting in easier calculations and much cheaper constructions. A recent example was the dome for the Auditorium Maximum at the University of Hamburg, which had a span of 200ft and a very irregular shape. It would have been extremely difficult to build it using only reinforced concrete. With prestressed concrete it was not really difficult, although mathematical calculations would have been rather complex. Instead, they had preferred to use model statics and to study on a model the influence of stress distribution, so as to arrive at a solution as far as possible free from bending moments.

Prestressing may also be used to avoid secondary stresses in a trussed girder. Originally, trussed girders were constructed with pin joints between the different members. This was found to be too expensive and the secondary stresses were conveniently forgotten, even though it was known that they were liable to be up to 60 per cent of the main stresses. Steel structures were usually fairly slender, which meant that the secondary stresses were relatively small : but in reinforced concrete trussed girders, these stresses normally reached some 150 or 200 per cent of the main stresses, rendering the structures unsafe. That was the main reason why trussed girders had not been used to a large extent in concrete. By prestressing, however, one could eliminate these secondary stresses. The speaker referred to a bridge with a span of 330ft, which was actually under construction. This carried an autobahn and an additional deck for local traffic. The whole was being built without scaffolding by cantilevering from temporary supports. It was interesting to note that the cost was some 50 per cent less than the cheapest tender for a steel structure. He had built the first trussed girders following this principle in 1942, for a big steel works. They were crane girders, each having a span of 100ft and supporting the roof, together with three 100-ton cranes with an additional load of 25 tons on one side and three 100-ton cranes on the other, 20-ton cranes on the top floor, and three cantilevering cranes of 10 tons. The live load was about three times the live load of the heaviest train in use on the railways and the torsional moment amounted to 1000 ton-ft.

A well-known example of precast units stressed together was the roof beams at London Airport. Not only beams but even shells could be subdivided into units suitable for precasting and subsequently stressed, a procedure particularly advantageous for shells because most of the forces did not act at right angles to the joints. Freyssinet was the first to produce by the use of prestress a high compressive force in such a joint, in order to create friction and thereby allow the forces to cross the joint at an angle.

There was the further possibility of building bridges by construction methods similar to those used for steel construction, i.e. building out gradually from the abutments. Scaffolding was replaced by a carriage rolling on the part of the bridge already built. A bridge was recently built by this method in sections of about 10ft each, at the rate of a section a week. Every construction joint was put in a state of stress by prestressing back to the previous section. The difficulty was that the stress distribution during the construction altered nearly every day, and the amount of prestress had to be changed to correspond to the state of the stresses at each stage. The first prestress—about half the full amount—was applied when the concrete was eighteen hours old ; one day later it was brought up to the full amount. Only prestressing made it possible to adjust the stress distribution daily. The bridge is illustrated on page 471.

Precision Optical Measuring Equipment

AN exhibition of precision optical measuring equipment was held during the period March 9 to 14, at the premises of Degenhardt and Co., Ltd., 6, Cavendish Square, London, W.1. The firm, which represents Carl Zeiss, Oberkochen, and M. Hensoldt and Soehne, Wetzlar, presented a range of Zeiss measuring microscopes as well as interference and light section microscopes. Other equipment included spectro-photometers, stereo-microscopes, and the " Ultraphot " automatic camera microscope. It is an important design principle of the Zeiss works, and one which rationalises production and lowers costs, to use a limited number of standard optical and mechanical components and sub-assemblies in various combinations, in order to obtain a variety of different universal or special-purpose instruments. This applies, among other things, to the large measuring microscopes which were on show, which made use of many identical optical components, but differed in layout, the method of taking readings, and also in the ultimate accuracy obtainable. This point is illustrated by a comparison of Figs. 1 and 2, showing respectively the " UMM " universal measuring microscope and the large toolmaker's measuring microcope.

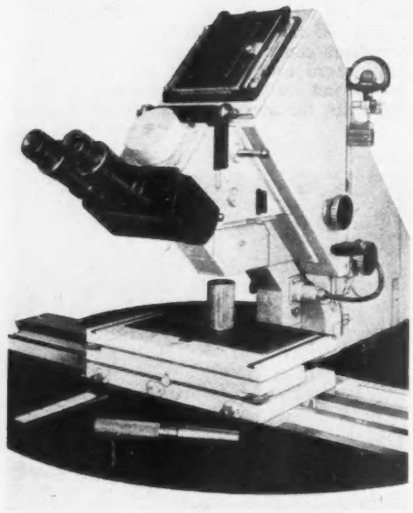


Fig. 1—Universal measuring microscope. The adjustable stage is controlled by handwheels in front of the table (not visible). A set of push-buttons on the table top gives a binocular view of the test piece or any of five precision glass scales

The universal measuring microscope is designed for a wide range of applications and for ease and comfort of handling, based on measurements by means of glass scales which can be read to 1 micron (0·00005in) and one minute of arc. The linear scales are read in conjunction with diagonally ruled eyepiece scales. A sixfold push button control brings into view in the binocular eyepiece the object or any of the glass scales for longitudinal and transverse movement, angular movement of microscope body or circular stage, and angle of tilt. Measurements are therefore possible in rectangular, polar or cylindrical co-ordinates. The vertical focusing movement can be used for measurements in that direction by means of gauge blocks and dial gauges. Magnification is from 10× to 80×. The objectives are readily interchangeable with one another or with a mechanical, spring-pivot mounted feeler, the displacement of which can be read optically through the eyepiece (by the double-image method described below).

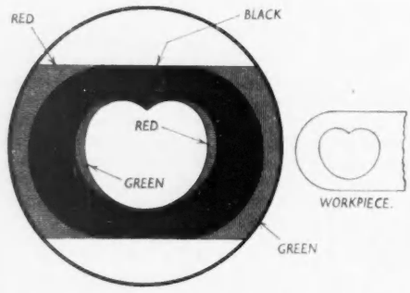


Fig. 3—Symmetry checking by shadow double image method

The test piece can be examined visually, projected on to a ground glass screen or photographed. It is possible to compare the projection or the viewed outline with a superimposed transparent drawing or reticle profile. For odd-shaped pieces where the number does not justify the making of a reticle inset, a novel method of comparison can be applied. This consists in viewing through the binocular the superimposed views of the projected profile of the object (in red) and of a transparent drawing of the part (in green) mounted in place of the ground glass screen. Portions where material must be removed show up black, those where too much has been removed appear white. Since the drawing is compared with the fully enlarged view of the part, high accuracy is achieved. Alternatively, a flat object up to 180mm long can be placed in the position of the ground glass screen (in a diagonal direction) and can be compared with a diminished photographic outline placed on the microscope stage.

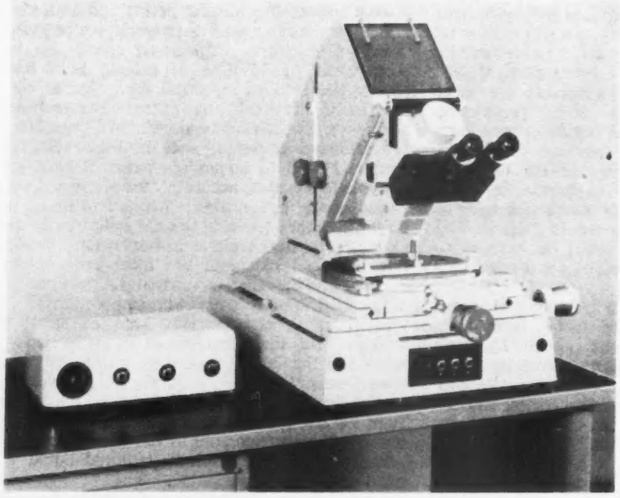


Fig. 2—Large toolmaker's measuring microscope with built-in projection device

Special equipment is

available for checking components which cannot be projected sharply, such as threads, for which flank contact blades are supplied with engraved reference lines parallel to the edge.

Roundness or degree of symmetry can be checked by optically superimposing a red direct and a green reversed image (Fig. 3). Distances

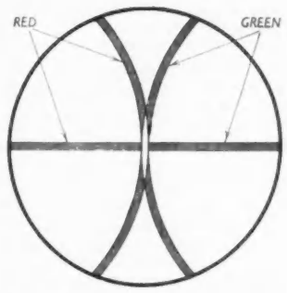


Fig. 4—Field of view—measurement of a bore by means of the optical internal measuring device (reference marks double image method)

between holes (even polygonal or unsymmetrical holes) can be determined quickly by matching two axially symmetric images, when the centre of gravity of the hole is in the optical axis of the microscope. Another method produces the image of crossed slits in the measuring plane, where it is observed under the microscope. The slits are adjusted to lie exactly on the optical axis of the instrument. The test piece lies between the projector and microscope, and the projected cross slits are reflected from the surface to be measured. Only if the measuring face lies in the optical axis of the instrument will the projected slits appear as one set ; otherwise, a double prism produces counter-moving double-slit crosses in complementary colours of red and green. When measuring holes, one of the slits appears curved (Fig. 4). In this case, the complementary images are set for symmetry. It is stated that this method is particularly valuable for unusually deep and small holes, taper parts, and snap and ring gauges. Although the use of complementary colours facilitates adjusting the microscope, equal accuracy can be achieved by a colour-blind person.

The large toolmaker's microscope has a similar optical system (but can also be supplied without projector). Readings are taken longitudinally and transversely to 0·0002in, using 1in gauge block steps and micrometer screws within each step. The cross slide can be displaced over a range of 6in by 3in and carries a circular stage which can be read by vernier to six minutes of arc.

Siemens and Halske and Siemens-Schuckertwerke

In the Report for the year ended on September 30, 1958, and submitted to the Annual General Meeting on March 5, Siemens and Halske Aktiengesellschaft show a turnover of DM.991 million, and Siemens-Schuckertwerke Aktiengesellschaft a turnover of DM.1599 million. Together with DM.692 million of the other German companies of the concern, this gives a gross total of DM.3282 million, or after deduction of internal deliveries, DM.2937 million, compared with DM.2844 million in 1956–57. The totals can be analysed into DM.2143 (2056) million domestic turnover, and DM.794 (788) million exports. Staff in Germany numbered 164,000 (160,000) and 15,000 (14,000) abroad. The foreign factories and trading companies had a turnover of DM.400 million.

Siemens and Halske A.G.

A new teleprinter put on the market by Wernerwerk für Telegrafen-und Signaltechnik, is stated to be capable of increased printing speeds. The German Federal Railway proceeded with the installation of further diagrammatic control board signalboxes and automatic track control equipment. Other items on the production programme include sealed polarised and unpolarised relays, a resonance relay, digital and analogue computers, and 16mm and 8mm cinematograph projectors with sound recording track.

The Wernerwerk für Fernsprechtechnik continued its production of "EMD" rare metal motor selector switches. In the Federal Republic, already 70 per cent of all trunk connections are being dialled by the subscribers themselves, using this type of selector, which has also been installed in Luxembourg. For the first time an international self-dialling connection has been established in the shape of a connection between Germany and Luxembourg. In the U.S.A. the first local exchanges using the "EMD-M" systems came into service. This system, which has also been ordered by the Union of South Africa, uses markers for controlling the selector operation ; the use of delay lines enables subscriber numbers with any number of digits to be dealt with. "ESK" extension switchboards have been adopted for the central switching installations of the German regional trunk connections.

The Wernerwerk für Weitverkehrs-und Kabeltechnik had as its main task the increase of channels of multiplex telephony links. A carrier frequency system with a bandwidth of 12 Mc/s was developed which offers 2700 speech channels per coaxial cable, or alternatively, a television channel and 1200 telephone channels. The carrier width of the 4 Gc/s v.h.f. post office links was also widened from 600 to 960 circuits for each of six pairs of channels. A 6 Gc/s link was installed between Stockholm and Malmö.

For bridging long distances by means of two end stations, a 2 Gc/s tropospherical scattered beam system has been developed with 120 telephone circuits for each wireless channel. The first installation of this kind, using 1kW transmitters and 10m diameter reflectors, was put into service between Berlin and Western Germany, a distance of over 200km.

In the Wernerwerk für Messtechnik a combined electro-pneumatic remote control system has been developed on the unit principle. Instrumentation is being supplied in conjunction with Siemens-Schuckertwerke A.G., for the Karlsruhe research reactor, the first reactor of German design. Among other designs are mentioned the "Inframeter" firedamp recorder ; magnetic test instruments for the quality control of transformer sheets; a control gear for cathode-ray tube recordings of fast, single events ; a recording gas chromatograph based on thermal conductivity, for the rapid analysis of hydrocarbon mixtures ; a fine structure X-ray spectrograph, also suitable for fluorescence analysis of solid, powder, or liquid samples containing one or more of eighty elements—the sensitivity is quoted as 10^{-3} to 10^{-4} per cent. For the "Elmiscop I" electron microscope, a universal diffraction equipment and a water-cooled object carrier have been produced. The company has begun the production of equipment for isotope laboratories. The magnetic recording of television programmes by the American "Ampex" system is being adapted to the European (CCIR) television standards.

Developments in the Wernerwerk für Bauelemente component factory were chiefly along the lines of smaller dimensions and higher working temperatures and frequencies. The use of etched circuits was expanded.

Siemens-Schuckertwerke Aktiengesellschaft

Work was begun on high-temperature gas discharges in connection with nuclear fusion. It was now possible to use Hall generators to read magnetic tape recordings. Analytic procedures included activation analysis through neutron bombardment. Together with Siemens and Halske A.G. a process for purifying silicon had been developed which, it is stated, yields the purest silicon in the world ; many German and foreign firms had obtained licences. Other development work included the production of cold by thermo-electric means (Peltier effect) ; here the efficiency of the thermo-electric elements was greatly increased.

Sintering techniques were applied to the manufacture of contact materials. A climatic testing laboratory has been set up.

A co-operation agreement regarding the industrial application of nuclear energy had been concluded with the United States Westinghouse Electric Corporation. A small testing reactor similar to the "Argonaut" design was under construction. A 100MW power reactor had been designed which used natural uranium and a heavy water moderator.*

Production of small industrial turbines had been transferred from the Mülheim factory to a new plant at Wesel. Development and production of control equipment was to be concentrated in a plant at Munich which was currently being built. Further progress had been made with the automatic operation of the West German grid, for which material was supplied. Turbine orders included seven units of 100MW to 150MW.

In the field of silicon rectifiers, orders had been received for several large-scale installations for 280V to 750V, totalling 400,000A. Current capacity of selenium rectifiers could be improved by 50 per cent. A small single-anode grid-controlled mercury arc rectifier had been developed. The "Siemens-Transidyn" system of rack-mounted unit control elements was being applied to a further seven mine hoists, two rolling mill reversing drives, and two cold-rolling mills.

Silicon rectifiers had also opened up new possibilities for 50 c/s locomotives and for substations of d.c. railway lines. The first locomotive equipped with Siemens silicon rectifiers had been in successful operation since May, 1957. A two-frequency locomotive for use with 16⅔ or 50 c/s was under construction.

In the field of low voltage distribution, there had been the development of the steel-enclosed "EN System" and that of the insulator-enclosed "I-System." Progress had been made with the miniaturisation of low voltage switchgear, including the use of semi-conductor elements. During the year under review the first "Protodur" 30kV cable had been commissioned. Besides oil-filled cables, the firm had developed a gas-filled cable for 110kV.

Expansion of French Oil Industry

The third French Modernisation and Equipment Plan, which ends in 1961, has now been supplemented by an expansion programme of the oil industry extending to 1965. Petroleum products consumption for 1961 is scheduled to reach 27,500,000 tons, and 36,000,000 tons in 1965. This requires an expansion of refinery capacity from 35,000,000 tons per annum at present, to 43,000,000 tons by 1961, and 54,000,000 tons by 1965, including a capacity of 4,000,000 tons in North Africa. Important installations at Strasbourg will be supplied by pipeline from Marseille, which may be extended through Germany to Rotterdam.

Crude oil production in the French area is to be increased to 20,000,000 tons in 1961, and 30,000,000 tons in 1965, mostly from the Sahara. Middle East oil is not included in these figures. The wells at Hassi Messaud are expected to yield 11,000,000 tons by 1961, and those at Edjelé, 5,000,000 tons.

A daily production of purified natural gas of 20,000,000 cubic metres will be obtained from south-west France by 1961, and it is intended to step this up to 30,000,000 cubic metres per day if possible. There are reserves of natural gas in the Sahara, at Hassi R'Mel, which have been estimated at 800,000 million cubic metres.

Investments in the energy sector between 1958 and 1961 inclusive, are placed at 2230 to 2280 milliard francs (including atomic energy). In the same period investments in the oil industry in the whole of the franc area are planned to reach 1100 to 1150 milliard francs.

Conference on High Energy Accelerators

An international conference on high energy accelerators and their instrumentation, sponsored by the International Union of Pure and Applied Physics (IUPAP) will be held at Geneva from September 21 to 25, 1959. Participation is by invitation only, and correspondence should be addressed to CERN Conference Secretariat, Geneva 23, Switzerland.

* A decision to build this reactor as part of the German "500MW Programme" was taken on January 15. See THE ENGINEER, February 27, page 358.

Progress of the Tennessee Valley Authority

BY OUR AMERICAN EDITOR

No. III—(*Concluded from page* 439, *March* 13)

Construction Progress

THE major construction activities in the fiscal year 1958 centred on the new, large 100ft lift lock at the Wilson dam and on eight new steam-electric generating units at four steam power stations. One 180,000kW unit was placed in operation at the John Sevier steam power station, and construction was continuing on seven other units totalling 1,535,000kW. In addition to the new John Sevier unit, the steam-electric capacity of the system was increased by 27,500kW with the expiration of a contract reserving this amount of capacity at the Memphis steam power station for the Arkansas Power and Light Company. The Corps of Engineers placed three units totalling 75,000kW in operation in its Old Hickory dam on the Cumberland River ; the Aluminum Company added 50,000kW at its new Chilhowee dam on the Little Tennessee River and incorporated a small purchased plant. All told, the installed capacity of the integrated system was increased by 332,725kW. This was the smallest increment of generating capacity in any year since the fiscal year 1951. The largest addition of capacity was in the fiscal year 1955, with 1,734,300kW being placed in operation.

The construction of the new lock and canal project at the Wilson dam went forward at a good pace during the year, and 365,700 cubic yards of concrete—93 per cent of the total required—were placed. At the same time, the contractors making improvements in the 3-mile-long Florence canal leading to the lock had completed about 94 per cent of their work. The new lock, which will relieve the chief bottleneck to the increasing traffic on the Tennessee, is scheduled for initial operation in April, 1959. The new lock will have a lift of 100ft, said to be the highest in the world. It will have a lock chamber 600ft long and 110ft wide, like those at the Kentucky and Pickwick Landing dams downstream. The entire project involves the construction of the lock proper, deepening and widening the Florence canal, elimination of lock and dam No. 1 at the lower end of the canal, and construction of a highway bridge over the new lock and the existing small lock system. While the new lock is under construction, river traffic is routed through a temporary canal to the present locks. When the new lock goes into operation modifications are to be made in the present locks—chiefly deepening the lower chamber—and they will be kept in stand-by for auxiliary use when needed. (Figs. 6 and 8 *ante*.)

Construction of new generating capacity was carried on at four steam power plants during the year. At John Sevier, the fourth unit was added, completing the presently planned major construction. At Widows Creek, on-site construction was started on a new large unit.

The transmission system connecting the generating plants to each other and to the loads in the area was increased by 368 circuit miles. At the end of the fiscal year there were 11,369 circuit miles in service. A heavy construction programme was carried on to connect the new generating units to the system, and there was a net addition of 202 miles of 161kV lines. The major 161kV projects completed included a 79-mile double circuit line from the John Sevier steam power station to Alcoa ; a 24-mile line from the Colbert steam power plant to a new Reynolds aluminium reduction plant near Sheffield, Alabama, a 48-mile line from Murfreesboro, Tennessee, to the Arnold Engineering Development Centre of the U.S. Air Force at Tullahoma, Tennessee, and a 64-mile line from the Johnsonville steam power station to Mayfield, Kentucky.

Approximately 5000 miles of communication facilities were added during the year to keep pace with the increase in generating and transmission capacity. The services include telephone, telemetering, pilot relay, facsimile, teletype and supervisory control. For the most part they operate over self-owned power line carrier, telephone line carrier, open wire lines and microwave radio. Some newly developed equipment was placed in operation as a result of research in which manufacturers and T.V.A. collaborated. The new equipment effectively doubles the number of transmission line carrier communication circuits which can be operated in the limited range assigned to this service.

Facilities were added to transmit data between the power system despatchers and the IBM 704 computer centre in Chattanooga engaged in determining the economic loading of the system. At the end of the year, more than 23,000 miles of telephone circuits and 37,000 miles of other types of communication were in operation. About 35 per cent of the total circuit mileage was in microwave radio. These services supplement the normal services of the public telephone system and provide additional reliability and speed.

The now twenty-five-year-old policy of constructing major projects in a progressive programme by force account continued in 1958 to demonstrate advantages in economy and speed. Both in manpower and equipment, such a programme saves money, time and skills. For example, as the fourth unit at the John Sevier steam power station was completed, T.V.A. began transferring its trained construction personnel to the new job of installing the seventh unit at the Widows Creek steam power station. Force account construction has been standard practice at T.V.A., with contract work being also used where advantageous. Many trained workers have moved from dam to dam and steam power station to steam power station as the construction progressed. In co-operation with the trade unions in the Valley, T.V.A. has sponsored apprentice and educational programmes to provide opportunities for workers to increase their skills. In an area which twenty-five years ago was primarily agricultural, this has provided a reservoir of trained construction and other workers who not only contribute to the efficiency of, but find rewarding work in, the expanding industrial economy of the Tennessee Valley and the South-east. A quarter of a million people have worked for T.V.A. during its existence.

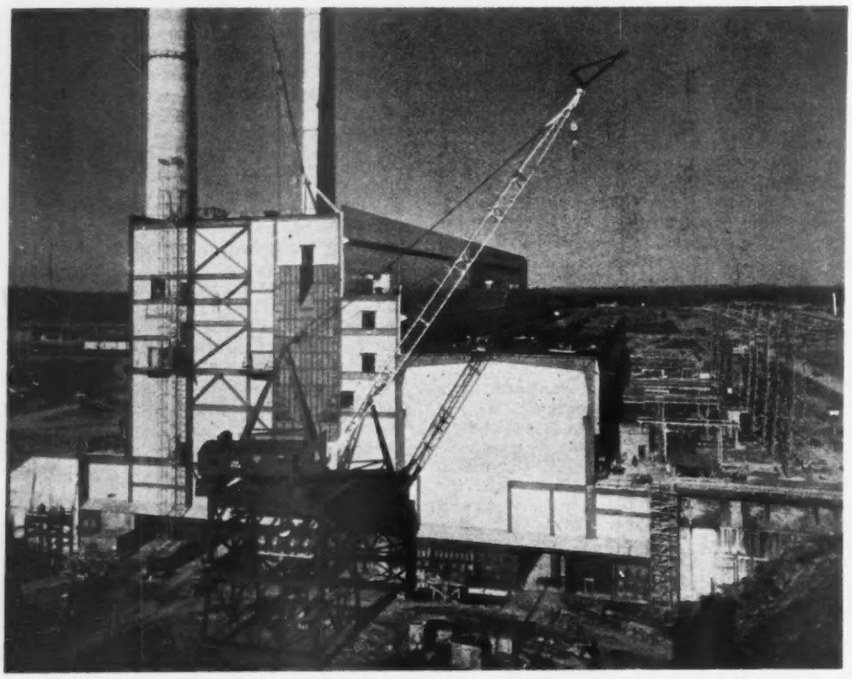


Fig. 11—Construction of final stage of the Gallatin steam power station housing two 247·5MW turbo-generator units

Wilson Dam Lock

The new lock now being completed at the Wilson dam, near Florence, Alabama, is situated at a point where, in earlier times, shoals and rapids severely hampered and occasionally prevented navigation in a reach of the Tennessee River that drops nearly 100ft in 27 miles. Begun in July, 1956, the lock structure is scheduled for initial operation next month, to augment the existing locks. The entire project, including deepening of one of the present lock chambers and related canal changes, will be completed about March, 1960, and the total project cost is estimated at 35,000,000 dollars.

Situated on the north river bank, the present navigation facilities consist of a double-lift lock at the dam, a canal 2¾ miles long below the dam, separated from the main river channel by Patton Island, and a single-lift lock and dam at the lower end of the canal. The double-lift lock has two chambers in tandem with a combined lift of 90ft ; these chambers are separated from the spillway by a 200ft non-overflow dam section. The dimensions of the upper and lower chambers are 60ft by 292ft and 60ft by 300ft respectively. The lock at the lower end of the canal has a maximum lift of 10ft ; its lock chamber is 60ft by 298ft.

To accommodate the new 110ft by 600ft lock chamber in the existing dam structure, eight spillway gates adjacent to the present tandem lock facilities were removed. The resulting reduction of spillway capacity, from the original fifty-eight gates to fifty, was made possible by the combined effect of upstream river regulation, virtually non-existent when the dam was built, and the installation of additional power units at the dam. The new lock chamber is entirely downstream from the dam to avoid a very costly upstream cofferdam in over 80ft of water. The upper sill and gate rest on the old dam. The lock walls extend downstream 800ft supplemented by a spillway guide wall 635ft long. To handle the 100ft total lift, a double-leaf

mitre gate 117ft high was installed at the downstream end.

The 20,000 cusecs of water needed to fill the lock chamber are admitted through a 15ft by 15ft culvert extending the length of the chamber in each wall. These two culverts terminate upstream at bellmouth intakes, 15ft by 23ft, in the dam face ; downstream they make a 90 deg. turn and discharge into the dam spillway channel. Tainter gate valves, at both ends of each culvert, control the flow to and from the ports of the lock-floor lateral system. Final filling can be accelerated by lowering the upper gate to permit spilling into the chamber, while supplementary final emptying will be accomplished through ports under the lower gate. The latter is necessary because the water level in the canal averages 5ft below the river level at the point of discharge. Filling will take about twelve minutes, and the full locking cycle an average of forty-five minutes.

The downstream guard walls are of conventional design. However, the upstream guard wall, 555ft long, is a floating reinforced concrete boom similar to that in successful use at the Kentucky dam. A high-level bridge will span both the new and the old locks, thus eliminating traffic interruptions on the river and on the dam roadway. The canal alignment has been altered to provide a better sailing line with respect to the railway and highway bridges downstream. This involved by-passing the existing downstream canal lock and dam and required deepening of the present lower tandem lock chamber and the canal by 10ft.

The construction programme, which began in July, 1956, proceeded according to a critically timed schedule, which permitted a minimum of delay to traffic on the roadway over the dam and virtually no interruption to navigation. The chief operations involved were the construction of the new lock chamber, including existing spillway alterations ; excavation for and maintenance of a temporary canal while the existing canal was being deepened ; realignment of the canal at the downstream end ; erection of a high-level bridge over the new and existing locks ; and deepening of the existing lower lock chamber so that the tandem lock can function as an auxiliary unit without the 10ft of lift now provided at the canal lock.

Very limited space was available for the construction plant. The concrete mixing plant, with three 2 cubic yard tilting mixers, was situated just downstream from the land wall of the new lock. It was supplied with graded aggregates by conveyor from a 50,000-ton storage area located in a small ravine adjacent to the main construction plant. The concrete mixes were specially designed and tested to utilise limestone aggregates and fly ash supplied from the Colbert steam power station. From the construction plant area on the bluff to the floor elevation of the new lock, trucks and other heavy equipment had to drop 120ft in a horizontal distance of only 800ft. To accomplish this, 1950 lineal feet of bridge and roadway were required to obtain a suitable grade. The through-truss span bridge crossed the existing lower lock chamber on a 5 per cent grade at an angle of 78 deg., and had a navigation clearance of 52ft. On the same grade, a timber trestle then made a 68 deg. turn upstream and connected with two steel trusses, almost parallel to the new lock, which descended on a 7 per cent slope to a rock-filled crib abutment and roadway. The roadway made a complete reverse turn and continued downstream on a 5 per cent grade into the work area.

Eleven closely-timed cofferdam changes were necessary for the new lock construction and to permit deepening of the upper canal and the old lock areas. In addition, seven temporary or permanent dykes were required to allow canal deepening, to make canal alignment changes at the downstream end and to maintain navigation while this work proceeded. The cofferdam for the main lock was designed as a standard cellular steel sheet-pile structure, but difficulty in obtaining sheet-piling necessitated the substitution of a timber rock-filled crib section 200ft long from the spillway and across the apron of the existing dam. In the remaining section there were twenty-eight sheet-pile cells, each 36·6ft in diameter and about 38ft high. The cell farthest downstream was tied to the existing concrete guard wall by a sheet-pile cut-off wall supported by berms of clay and rock. The gravel-filled cofferdam cells were grouted on the river side and backed up on the lock side by riprap.

The erection of the main cofferdam on ledge rock was complicated by the presence of large limestone slabs, some containing up to 100 cubic yards and weighing 200 tons. These had been displaced during high-water discharges and deposited in piles and windrows below the dam. Drilling and blasting were required to reduce these slabs to a size that could be handled by power shovels. In January and February, 1957, the cofferdams safely passed the Wilson dam

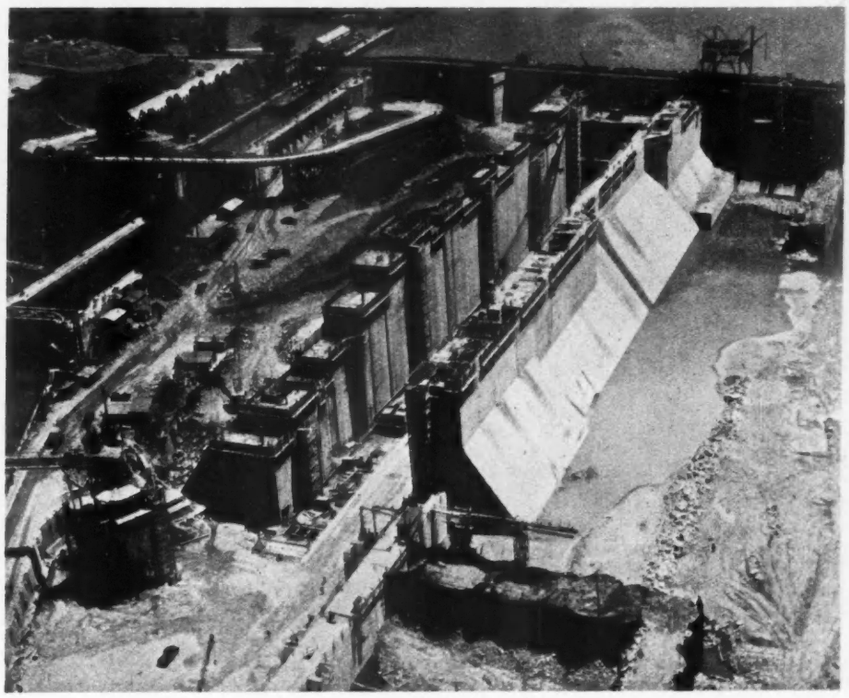


Fig. 12—Construction of new 600ft by 110ft lock chamber at the Wilson dam in Alabama, with original chamber at left

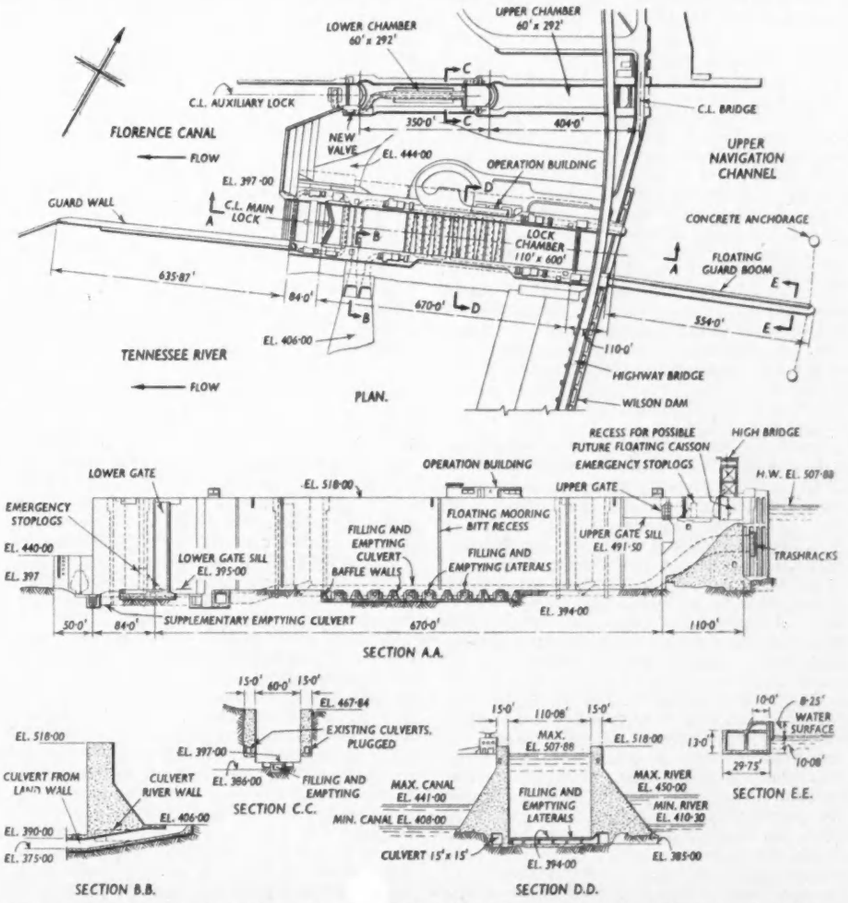


Fig. 13—Plan and sectional elevations of new [illegible]ft by 110ft lock chamber at the Wilson dam in Alabama

Fig. 14—Concrete placing operations during the construction of the lock walls

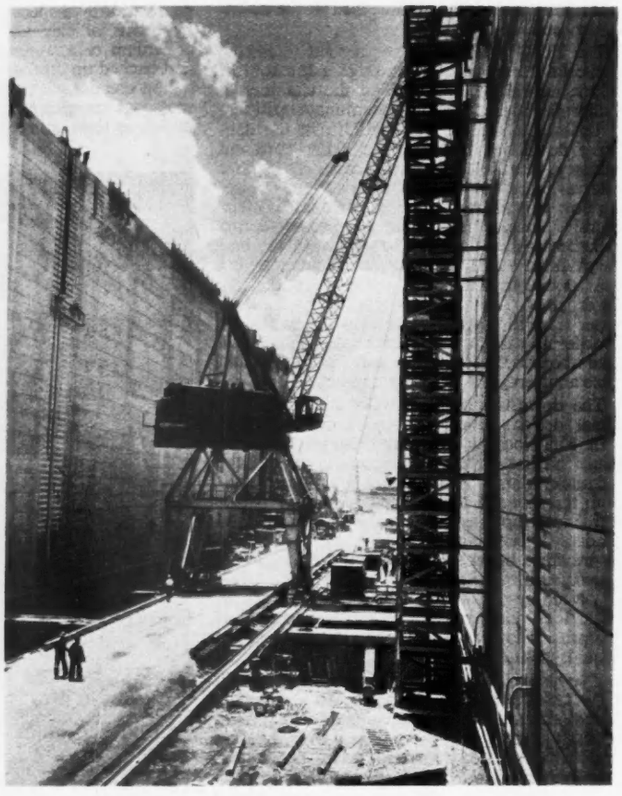


Fig. 15—40-ton " American " gantry crane mounted on lock-floor rails employed for concrete placing

flood of record involving a flow of 372,000 cusecs. Rock excavation for the new lock, totalling about 200,000 cubic yards of a shaly limestone, was completed on schedule in eight months, utilising conventional equipment and carbide-tipped tool bits. The fifteen-month concreting operation, during which over 375,000 cubic yards will be placed, is now approaching completion (Figs. 14 and 15). Concrete placement averaged 1800 cubic yards per day with 2100 cubic yard peaks while working in big blocks. Concreting is done on the two night shifts, the day shift being reserved for form changes and other construction.

The passage of water through the dam to fill the lock presented a special construction problem. Two passages, one in each lock wall to supply the filling culverts, required the removal of the dam concrete without disturbing the old structure. It was possible to remove part of the concrete by an open shooting procedure on the downstream face. However, stability considerations for the old dam limited this to about 16ft of the total 42ft cut.

Before further tunnelling could be carried out, it was necessary to place the concrete for the upper gate sill to approximate final elevation and to concrete the lock walls to above lake level. The lock walls were built up at the back of a floating bulkhead regularly used for gate repair. The sill and wall blocks loaded the spillway, in addition to stabilising the spillway piers against the horizontal pressure of the bulkhead upstream. The tunnel cut, 19ft by 27ft, or 15ft by 23ft after lining with concrete, removed about one-fourth of the dam volume in that section.

To seal off the Wilson reservoir while culvert tunnelling and concreting operations were under way, a 200-ton floating bulkhead, 46ft by 74ft, was built of high-strength steel plate. This bulkhead was a 3ft deep, all-welded, cellular structure whose sides and bottom fitted against the upstream face of the dam. Because of the rough and irregular surface of the dam concrete, it was necessary for a diver, using a series of vertical tight-wires, to plot the configuration of the dam face. From this information sealing details were worked out, using shaped timbers and rubber seals. The bulkhead was positioned by flooding the three lower compartments, thus turning it to a vertical position. It was then sunk to the right depth in front of the culvert opening and pulled tight by cables. Water was pumped out from behind it to a point just below the spillway crest. The spillway gate was then removed and all water pumped out, thus allowing external water pressure to complete the sealing of the bulkhead. A similar procedure will be used at the other culvert entrance.

With the bulkhead in place and unwatered, a carefully planned and executed tunnelling programme began. Starting from the previously excavated downstream face, three advances of 6ft and one of 6ft to 8ft were made. Before the final 6ft to 8ft advance, the culvert stoplog was positioned to prevent area flooding should the bulkhead become damaged. A timber platform was constructed in the bulkhead to catch falling concrete and a timber mat placed over the culvert entrance area. Line drilling was carried completely through the entire section and the enlarged pilot-hole broached through to the bulkhead void. Blast holes, on 18in centres, were drilled to within 18in of the upstream face of the dam. Using only $\frac{5}{8}$ lb of dynamite per hole—$\frac{3}{8}$ lb at the front and $\frac{1}{4}$ lb at the back of each hole—the section was pulled to the pilot hole. The remaining concrete, already cracked by adjacent excavation, was chipped and wedged out. The closeness of both the bulkhead and the dam construction joint made the removal of the last section particularly critical.

A high-level bridge over the navigation channels replaces the roadway on the dam and the bascule bridge at the original lock. The removal of the roadway arches and piers in the new lock area was a rather difficult job which had to be closely timed and planned for accomplishment during the four-month period when the roadway was out of service during the erection of the high-level bridge. Four existing roadway arches weighing 1580 tons each and three piers weighing 460 tons each had to be cut into 20-ton to 40-ton pieces, loaded on barges, and disposed of upstream in Wilson Lake. Just before the closing of the original roadway in December, 1958, 16ft of the downstream roadway section were removed across all four arches, reducing traffic to one lane. After the road was closed, the remaining 11ft 6in of the roadway section and the 19ft gate section were removed, allowing concrete to be placed in the bridge foundations in this area and in the lock walls up to final grade.

A floating guard boom, 555ft by 27ft, on the spillway side of the lock, will guide vessels into the upstream entrance. This concrete boom will be built in six sections in an area just downstream from the new lock and floated when the area cofferdam is flooded. The sections will be assembled in the lock chamber and towed into the lake above the dam. Assembly, by bolting, will be facilitated by the temporary flooding of the compartments to align the boxes. The downstream end of the floating boom will be fastened to the lock wall. The upstream end, or nose, of the boom must have two anchors to hold it in position in over 80ft of water. The scheme currently favoured is to use 900-ton anchor blocks made as open-ended cylinders 27ft in diameter and 20ft high, constructed of steel plate and internally braced. Provision will be made to centre a tremie pipe in the cylinder and hold it there while placing some 450 cubic yards of concrete under water from a floating plant.

In the Florence Canal and the temporary canal downstream from the lock, the Massman Construction Company and the Farrell Construction Company moved 3,200,000 cubic yards of material. The temporary canal, 100ft wide, excavated mostly in the dry, permitted navigation to continue without interruption while the contractor deepened the existing 300ft wide Florence Canal and relocated the lower end to by-pass the canal lock of 10ft lift. Once the new lock and the reconstructed Florence Canal are in operation, the old tandem lock can be taken out of service and unwatered. The machinery and gates for both locks will then be given a general overhaul. The lowering of the downstream lock floor by 10ft required an excavation totalling about 21ft in depth so that a new filling and emptying culvert could be built into the floor. The existing wall culverts will be plugged. Repairs will be made to the down-

stream wall blocks and a 10ft extension will have to be added to the downstream mitre gate.

The design and construction of the new lock was under the supervision of the T.V.A. Office of Engineering, Knoxville, of which George K. Leonard is Chief Engineer and Henry T. Lofft is Chief Construction Engineer.

500MW Parsons Turbo-Generator

On February 6, 1959, T.V.A. purchased a 500MW turbo-generator, to be installed at the Colbert steam power station near Tuscumbia, Alabama, from C. A. Parsons and Co., Ltd. The delivered price will be 12,095,800 dollars. The purchase was made under competitive bidding procedures required by the T.V.A. Act and was based on the following considerations :

(1) The evaluated Parsons bid was more than 6,000,000 dollars lower than the evaluated bids of the only other bidders—the Westinghouse Electric Corporation and the General Electric Company—both American firms.

(2) Full compliance with the provisions of the Buy American Act and established national policy on foreign purchases.

(3) A determination that Parsons is qualified, technically competent and adequately equipped to build and deliver the turbo-generator on schedule.

(4) Assurance that Parsons is able to provide promptly any repair service and replacement parts which may be necessary during the life of the machine.

For some time T.V.A. has been disturbed by the rising prices of turbo-generators. There are only three American firms which manufacture large turbo-generators. Since 1951 the prices charged by these manufacturers for such equipment have increased by more than 50 per cent, while the average wholesale price of all commodities has increased only about 5 per cent. It was this history of price increases by the only United States suppliers which led T.V.A. to invite bids from qualified foreign manufacturers as well as domestic ones.

T.V.A. invited bids from the three United States manufacturers and the two leading British manufacturers of large steam power generating equipment. Bids were received from three companies : Westinghouse, General Electric and Parsons. In its invitation to bidders T.V.A. set forth certain factors that would be taken into account in comparing bids. These included differences in guaranteed efficiency of the machine, differences in escalation of prices and willingness of the manufacturer to pay specified damages if the machine were not delivered on time.

Before reflecting the evaluation factors just referred to, the base bids received were as follows :

Parsons (including duty)	12,095,800 dollars
General Electric	17,563,000 dollars
Westinghouse	17,633,000 dollars

The Parsons price was firm, while the bids from General Electric and Westinghouse were subject to escalation clauses. After adjustments for efficiency and escalation, the evaluated bids compared as follows :

Parsons	13,140,700 dollars
Westinghouse	19,453,725 dollars
General Electric	19,673,780 dollars

The evaluated General Electric and Westinghouse bids were thus nearly 50 per cent higher than the Parsons bid. Moreover, of the three bidders only Parsons indicated a willingness to accept a contract containing the provision specified in the invitation for payment of damages in the event of delay in delivery. General Electric and Westinghouse both took specific exception to the provision. This exception constituted a material deviation from the terms of the invitation which rendered their bids unresponsive and unacceptable even if one of them had been a low bidder. This provision for liquidated damages is a very important one. A number of the large generating units which T.V.A. has bought in recent years have been delivered late, and T.V.A. has had to incur substantial additional costs as a result. Inclusion of a liquidated damages provision in the final contract gives T.V.A. added assurance that Parsons will give its full attention to making delivery within the time necessary to meet T.V.A.'s requirements as specified in the invitation.

National policy governing purchases of foreign equipment has been established by the Congress in the Buy American Act and by the President, in Executive Order 10582 of December 17, 1954, prescribing the manner in which all Federal agencies shall apply the Buy American Act. The Act provides generally for purchase of domestic articles, materials and supplies, unless their cost is determined to be " unreasonable " as compared to foreign goods. The Executive Order provides that ordinarily the " offered price of materials of domestic origin shall be deemed to be unreasonable " and purchase shall be made from competing foreign source if the domestic price exceeds the amount of a foreign bid by more than 6 per cent. If the low domestic bidder is in an area of substantial unemployment, a 12 per cent differential is used in accordance with a recommendation of the Council on Foreign Economic Policy.

T.V.A. stated in its invitation for bids on the 500MW turbo-generator that it would accept the lowest bid from a U.S. manufacturer if it did not exceed the lowest foreign bid by more than 20 per cent. Such an increase in the price advantage for domestic manufacturers is permitted under the Executive Order if the Government Agency involved determines that it has sufficient reason to increase the differential. If, under these conditions, purchase is made from a domestic manufacturer the agency is required to submit a special report on the matter to the President. This price advantage given to U.S. manufacturers was in addition to the import duty which would have to be paid by the foreign manufacturer. The import duty which will be paid by Parsons amounts to about 1,500,000 dollars. The additional 20 per cent advantage provided for domestic manufacturers, based on Parsons' evaluated bid, was over 2,600,000 dollars. Therefore, the total price advantage enjoyed by domestic bidders as a result of these two items alone amounted to over 4,000,000 dollars. Furthermore, foreign bidders had other added costs for such items as trans-ocean shipping and marine insurance.

One explanation which has been offered for the inability of American manufacturers to meet the foreign price competition in this field is the difference in wages paid in this country and abroad. Wages paid to workers in the electrical industry in England are lower than those paid by domestic manufacturers. Westinghouse says that British labour receives only 37 per cent of the hourly rate paid to the electrical workers here. General Electric has suggested that the ratio is 40 per cent. Westinghouse has told T.V.A. that 1,080,000 man-hours of work in its shops would have been involved in building the turbo-generator. General Electric is quoted as saying that 600 man-years of work, which is closely comparable to the Westinghouse man-hour estimate, would have been required. The U.S. Bureau of Labour Statistics reports the average hourly wage rate in the electrical manufacturing industry for October, 1958, was 2·28 dollars. The foregoing figures suggest that differences in labour costs would be in the neighbourhood of 1,500,000 dollars, and this does not allow for any greater manufacturing efficiency in the larger American works of General Electric and Westinghouse. This computed difference is less than half the price advantage provided for domestic manufacturers. In fact, it appears that the import duty is adequate to protect U.S. turbo-generator manufacturers against differences in labour costs.

Outside the United States the Parsons Company is the largest manufacturer of such equipment in the free world. Half of the turbo-generators it builds are exported. For example, it has built most of the steam power generating equipment that is operating in Canada. Parsons maintains service facilities and personnel in Canada, which are as favourably located as the corresponding facilities of the U.S. firms. Parsons and General Electric are the only two companies in the world known to be building units as large as 500MW, General Electric now being engaged in building one such unit, which T.V.A. ordered from it in the autumn of 1957.

All the foregoing has a bearing on the effect on national security of this purchase from a British firm. The Parsons Company has a good record of delivery on schedule, and its guarantee is backed up by a penalty clause in the contract. There are similar assurances that the machine will be highly efficient. Fears that competition by foreign firms will result in all or most large turbo-generators being manufactured abroad, thereby eliminating American productive capacity as a supply source in defence emergencies, are unfounded. It appears that the total capacity in the entire free world for producing such equipment is so limited that all of it, both in Europe and the United States, will normally be required to supply the large turbo-generators necessary to meet the rapidly increasing demands of this country and others for electric energy. In the event of total war, the problem of repair or replacement of generating units would be about the same whether they had been manufactured domestically or abroad. Any realistic contemplation of such a war must assume that American turbo-generator manufacturing plants could be destroyed or damaged in the same attack which might damage or destroy the unit installed in the Colbert steam power station. Early repair or replacement would seem unlikely no matter where the unit had been built.

In event of a less extensive attack or acts of sabotage, it should be recognised that generating units manufactured by all the major American suppliers are incorporated in the T.V.A. system. Wide-spread damage to the system could result in heavy demands on all these suppliers, both by T.V.A. and by utilities in other sections of the country. The addition of the Parsons unit to the T.V.A. system increases the number of suppliers who can be called on in the event of such an emergency and thereby reduces the risk of delay in getting maximum capacity back into service. The economical operation of the T.V.A. power system, to which the saving of more than 6,000,000 dollars contributes, is important in the national defence budget, since half of the power from the T.V.A. system goes to Federal defence installations. At the same time, the purchase of unit from Parsons strengthens the economic the position of an ally, Great Britain.

T.V.A. would regret any real net loss of employment for American workers from its purchase of an English turbo-generator. However, it seems more likely that there will be a net benefit to American labour. T.V.A. will make payment in dollars for its purchase from Parsons. It can reasonably be assumed that these dollars will be used to finance British purchases of other goods either in the United States or in third countries which will in turn use the dollars to make purchases in the United States. Those dollars can be expected to create and pay for as many man-hours of work in the United States as would have resulted from domestic manufacture of the turbo-generator.

The Parsons machine will be a cross-compound unit comprising two lines of turbines each driving a hydrogen-and liquid-cooled generator at a speed of 3600 r.p.m., and operating with steam at a pressure of 2400 lb per square inch, 1050 deg. Fah. temperature, with reheating to 1000 deg. Fah. Each line of the machine will comprise three double-flow turbines. One line will consist of a high-pressure turbine and two low-pressure turbines, whilst the second will comprise an intermediate-pressure turbine and a further two low-pressure turbines. Because of the high steam conditions, a double casing design will be used on both the high-pressure and intermediate-pressure cylinders. All the turbine shafts will be rigidly coupled including the couplings to the rotors of the generators.

The generators themselves will have a rating of 250MW, 0·9 p.f., 24kV, generating current at a frequency of 60 c/s. The rotors will be direct-gas-cooled, operating in hydrogen at a pressure of 45 lb per square inch. The stator winding will be cooled by liquid circulating through hollow stator conductors.

Holland-America Liner " Rotterdam."—The Holland-America Line states that the company's new flagship, the S.S. " Rotterdam," of 38,000 tons gross, will sail on her maiden voyage for New York from Southampton on September 4. The ship, which will be completely air conditioned, will provide accommodation for 500 first and 900 tourist-class passengers.

Personal and Business

Appointments

MRS. VIVIAN JUNE BURNS has been appointed a director of N. C. Brown, Ltd.

MR. B. EICHLER has been appointed a director of General Refractories, Ltd.

MR. D. P. PRESTWICH has joined the board of directors of Normand Electrical Company, Ltd.

MR. T. MARRIOTT has been appointed manager of the Oxford depot of Kerry's (Great Britain), Ltd.

MR. J. G. MARSDEN has joined Anti-Dust Services, Ltd., as general sales manager in charge of U.K. sales.

MR. NEILL GIBSON BENNETT has been elected a joint managing director of Graviner Manufacturing Company, Ltd.

MR. N. G. O'HARA has been appointed sales engineer for London and southern counties with E.C.C. (Moulded Breakers), Ltd.

MR. J. DOUGLAS ELSTONE has been appointed director of marketing, tractor division, David Brown Industries, Ltd., Meltham, Yorkshire.

MR. D. L. BROWN, M.I.Mech.E., has been appointed deputy manager of Smiths Aviation Division's research department at Cheltenham.

MR. D. W. HAWKINS, a former director and general manager of Dunlop Plantations, Ltd., has been appointed to the main board of the Dunlop Rubber Company, Ltd.

GEORGE ELLISON, Ltd., has announced the appointment of Mr. A. H. Lothian as sales and technical representative for Ellison hydraulic valves in Scotland and extreme North of England.

MR. R. D. BAIRD has been appointed a director of Baird and Tatlock (London), Ltd., and of Hopkin and Williams, Ltd. Mr. R. T. Beasley has joined the B.T.L. Group of Companies as personnel manager.

TURNER AND NEWALL, Ltd., announces that Mr. R. G. Soothill has been appointed chairman of the company in succession to the late Sir Walker Shepherd. Mr. R. M. Bateman has been appointed deputy chairman.

THE MINISTRY OF TRANSPORT AND CIVIL AVIATION states that Mr. J. E. Hampson has been appointed a deputy secretary. He will take charge of the inland transport part of the Ministry in succession to Mr. L. J. Dunnett.

MR. F. C. BOYS has been appointed as a commercial assistant to the product manager of the electro-acoustics department of Philips Electrical, Ltd. He will be responsible for the marketing of the company's new dictation machine.

MR. A. W. CLEEVE BARR, A.R.I.B.A., principal architect in the Ministry of Education, has been appointed chief architect in the Ministry of Housing and Local Government in succession to Mr. J. H. Forshaw, F.R.I.B.A. He will take up his duties in June.

MR. J. YATES has been appointed manager of Clarkson Engineering (Canada), Ltd., and will be working from the Toronto office at 767, Warden Avenue, Scarborough, Toronto. Mr. A. Goodey has replaced Mr. Yates as northern area manager for Clarkson (Engineers), Ltd.

BRITISH GEON, Ltd., announces that Mr. R. J. Facer has been appointed general sales manager. Mr. J. E. Richardson takes over as export manager from Mr. S. A. Williams who becomes administration manager (sales) Mr. G. Y. Blomeley has been appointed northern manager.

MR. LESLIE GAMAGE, chairman and managing director of The General Electric Company, Ltd., has been elected President of The British Electrical and Allied Manufacturers' Association (Incorporated) for 1959–60, and Mr. W. Kenneth G. Allen, chairman of W. H. Allen, Sons and Co., Ltd., has been elected chairman of the BEAMA Council for the same period.

DISTILLERS PLASTICS GROUP has announced that Mr. S. R. Badley has been appointed market development manager with effect from April 1. Mr. C. D. Harvey-Piper will take over from Mr. Badley as sales manager in charge of binder resins for British Resin Products, Ltd. Mr. L. R. Anthony has been appointed information officer, and Mr. A. E. Oates publicity officer for the Distillers Plastics Group.

THE MINISTRY OF SUPPLY announces that Mr. S. Scott Hall has been appointed head of the United Kingdom Ministry of Supply Staff in Australia in succession to Dr. W. H. Wheeler, who is returning to this country to take up an appointment as director of the Ministry's Explosives Research and Development Establishment at Waltham Abbey.

THE MINISTRY OF SUPPLY has announced that Sir Lewis Hutchinson, a deputy secretary in the Ministry, is to retire from the public service on March 31. His duties will be taken over by Mr. Peter Humphreys-Davies. Mr. D. W. G. L. Haviland has been appointed a deputy secretary and will assume the appointment vacated by Mr. Humphreys-Davies on April 1. Mr. G. Leitch has been promoted to the post of under-secretary (munitions supply) in the vacancy created by the promotion of Mr. Haviland.

MR. G. MORLEY DAVIES has been appointed press and information officer of the Electricity Council and will take up this appointment early next month, on the retirement of Mr. W. J. Hendry, who has been the council's public relations officer since it was established at the beginning of 1958.

Business Announcements

THE FIRTH CLEVELAND GROUP has acquired the whole of the issued share capital of Escott Brothers, Ltd., South Woodford, E.18 and its associated companies,

MR. F. B. HOLT, M.I.E.E., a local director of Higgs Motors, Ltd., is making a business trip to Africa. He will call on agents and distributors and investigate the possibilities of developing new outlets.

KETAY, Ltd., Eddes House, Eastern Avenue West, Romford, Essex, states that it is now a design approved manufacturer under the Ministry of Supply Instrument and Electrical Equipment Design Approval Scheme.

THE BERYLLIUM SMELTING COMPANY, Ltd., 36–38, Southampton Street, London, W.C.2, announces that it is marketing "Beryldur," a beryllium-copper alloy, on behalf of the Beryllium Corporation, Reading, Pennsylvania, U.S.A.

MR. J. H. BUYING, technical sales engineer of Marconi Instruments, Ltd., has left London by air for a three-month sales promotion tour of the African continent, during which he will visit the company's agents in nine countries.

ASHMORE, BENSON, PEASE AND CO., announces that it has concluded a licence arrangement with the Mond Nickel Company, Ltd., by which it is now in a position to supply S.G. or high ductile iron castings in accordance with British Standard Specification 2789/1956.

MR. D. F. HAYDON, chief technical sales representative of Baird and Tatlock (London), Ltd., and Hopkin and Williams, Ltd., is making a six-week tour in the Middle East. He will visit agents, representatives and customers in the Persian Gulf, Iraq, Iran and the Lebanon.

LONDON AND THAMES HAVEN OIL WHARVES, Ltd., has appointed Pencol Pipeline and Engineering Consultants, 19, Grosvenor Place, London, S.W.1, as consulting engineers and designers for its new multiple product automated road-car loading station which will have a capacity of 250,000 gallons per hour.

DAVID BROWN INDUSTRIES, Ltd., has signed an agreement giving the company exclusive manufacturing rights in Britain of a patent form of radiation shielding, perfected in America by Knapp Mills Inc., of New York. The shielding will be manufactured at the David Brown Jackson Division, Salford, Lancashire.

MR. R. E. HANCOCK, deputy export service manager of F. Perkins, Ltd., has started a three months' service tour in the Far East. He is calling on distributors, government departments, local authorities and private operators using Perkins engines in Malaya, Burma, Thailand, Hong Kong, Korea and the Philippines.

THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY has announced a reorganisation of the isotopes production and marketing which has hitherto been shared between the Radiochemical Centre at Amersham and the Isotope Division of A.E.R.E., Harwell. It has been decided to widen the scope of the Radiochemical Centre to form a single comprehensive organisation for producing and marketing all such isotopes. Dr. W. P. Grove has been appointed director of the reorganised Radiochemical Centre. Users of radio-isotopes should continue until they are advised of the new arrangements, to order their requirements from Amersham or Harwell as they have done in the past.

Contracts

THE DOWSETT GROUP OF ENGINEERING COMPANIES has signed a contract with the U.S.S.R. after negotiations with the Ministries of Electric Power Stations, Railways and Transport Construction, in connection with the usage of the "Dow-Mac Process" for the manufacture of prestressed, precast concrete units and the associated specialised machinery as developed by Dow-Mac (Products), Ltd. Delivery of technical information will begin during the middle of this year, to be followed by plant deliveries. The contract will be completed by the end of 1960. Initially, the value of the work is in excess of £500,000. Firm inquiries for expansion of the present work have already been received by Dow-Mac (Products), Ltd., and further offers are being prepared.

W. H. ALLEN, SONS AND CO., Ltd., has received a contract for machinery and equipment for two pumping stations, valued at £298,309, for the latest extension to the Liverpool Corporation's waterworks. The extension is the River Dee supply portion of the Tryweryn scheme. Five 10,000,000 gallons per day and two 5,000,000 gallons per day Allen vertically suspended pumps are to be supplied for the river intake station, and the same number of Allen two-stage pumps of similar capacity, but designed for a higher total head, will be installed in the high-lift pumping station. In addition, the contract includes the installation of associated constant and variable-speed motors, high-tension and low-tension switchgear, transformers, cabling, pipework and valves.

SIEMENS EDISON SWAN, Ltd., has received an order valued at approximately £150,000 from the Jordan Ministry of Communications for a complete automatic telephone exchange system to be installed in the Jerusalem area, with automatic dialling between exchanges and equipment for trunk working to other areas of the country. The new exchanges will provide automatic service for over 3000 subscribers, and provision is made for extension to more than 20,000 subscribers in due course. The cities concerned are Jerusalem, Ramallah, Jericho and Bethlehem. At Jerusalem, the main centre of the network, the exchange will serve 2000 subscribers and will terminate sixty multi-channel circuits for dialling between exchanges. Apparatus will be provided for thirty trunk lines to other areas in Jordan routed through an eight-position operator switchboard capable of expansion to twenty-four positions.

MARCONI'S WIRELESS TELEGRAPH COMPANY, Ltd., has received a contract from the Ministry of Supply, acting on behalf of the Air Ministry, for the planning, supply and installation of a high-power radio station at the R.A.F. Staging Post in the Maldive Islands. The transmitting station, on the island of Hitaddu, will be equipped with four 30kW, two 10kW and eight 3·5kW independent sideband transmitters. Receiving equipment on the island of Gan, approximately 6 miles from Hitaddu, will comprise six triple-diversity, independent sideband receivers; three double-diversity telegraph receivers; two frequency-shift Diplex receiving units, and two six-channel, two-tone, voice-frequency telegraph equipments. Communication between the islands will be effected by a duplicate S.H.F. multi-channel system, and all traffic from the Message Centre at Gan to the transmitters at Hitaddu will be carried by the same means.

BRITISH INSULATED CALLENDER'S CONSTRUCTION COMPANY, Ltd., a member of the B.I.C.C. group, has recently been awarded by the Central Electricity Generating Board a contract for the supply and installation of a second overhead crossing of the River Thames at a point about 8 miles downstream from the existing 132kV crossing at Dagenham. The new crossing is designed for a working voltage of 380kV, but will operate initially at 275kV. It will be located at West Thurrock on the Essex bank, and will enable a connection to be made to the Channel coast. Two three-phase circuits and a single earth wire will be provided. The conductors (the largest used on the British Supergrid) will be made in the B.I.C.C. Prescot works. Each conductor will consist of 108 strands of 0·15in diameter aluminium wire laid over a core of ninety-one strands of 0·123in diameter steel wire. The overall diameter will be slightly over 2¼in; the cross-sectional area will be equivalent to 1·167 square inches of copper, and the total weight of the six conductors and one earth wire will be approximately 153 tons. The continuous carrying capacity of each conductor will be 1550A. The crossing will have the usual arrangement of two suspension towers and two anchor towers. The minimum clearance of the conductors above high water will be 250ft. The lattice steel suspension towers will be 630ft high and the span between them will be 4500ft. The four towers, which will weigh some 950 tons all together, will be designed by Blaw Knox, Ltd.

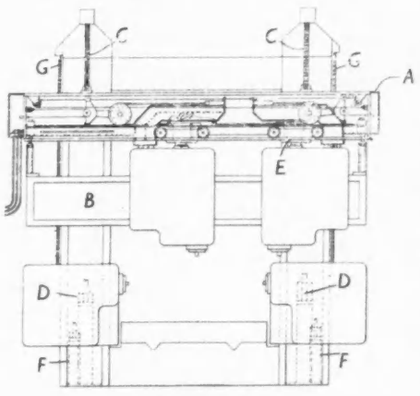
British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings, unless otherwise stated. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.

MACHINE TOOLS

808,009. August 27, 1956.—MACHINE TOOLS, Giddings and Lewis Machine Tool Company, Fond Du Lac, Wisconsin, United States of America.

This present invention relates generally to machine tools but more particularly to planer milling machines. Heretofore these machines have presented relatively serious alignment problems occasioned by the weight of the milling headstock and its offset or overhanging relationship with respect to the supporting structure upon which it is slidably mounted. The invention has as its general aim, the provision of a suspension system whereby the weight of the headstock assemblies is effectively supported in all positions to virtually eliminate the twisting, sagging, and bending of the cross-rail. The suspension mechanism is illustrated in the form of a support beam *A* suspended



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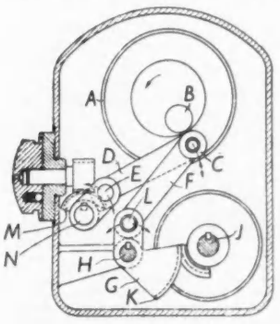
above and parallel to the cross-rail *B* by a pair of roller chains *C*. Each chain is connected to a hydraulic cylinder tensioning unit *D* in each column and passes over sprocket pulleys on the upper extremities of the columns to engage the support beam. Each of the headstock assemblies is in turn resiliently supported on the beam by a hydraulic suspending unit *E* secured to a trolley which rolls along tracks forming a part of the beam. Suspension or counter balancing means for each of the side heads are illustrated in the form of a separate hydraulic cylinder mechanism *F* for each side head, and connected to the headstocks by means of roller chains *G*. —*January* 28, 1959.

808,823. February 26, 1957.—FEED DEVICE FOR MACHINE TOOLS, Szerszamgepfejlesztö Intezet, Halásztelek, Hungary.

This relates to an adjustable feeding device for machine tools, and which has only one cam. The drawing shows a preferred embodiment of the



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invention. The eccentric path *A* is keyed on to a shaft *B* rotating in synchronism with the main shaft of the machine. This eccentric is provided with a groove in which a roller *C* is movable. This roller is at the end of an arm *D* pivoted at a point *E*. During rotation of the shaft the roller is moved up and down along a circular path with the pivot point. On a short bolt of the roller there is a driving arm *F* pivotally connected to a crank-lever *G* keyed to a shaft *H*. In consequence of the oscillating movements of the crank-lever the driven shaft *J* is rotated to and fro through gearing *K*. The alternating movements of shaft *J* are transformed into pulsating one-direction movements by a one-way ratchet clutch or like means to give the intended intermittent feed movement. For adjusting the length of feed strokes or infinitely varying the speed, the pivot point *E* is moved away from or towards the point *L* which is the centre of the pivot connecting the crank-lever to the driving arm *F*. For this purpose there is provided a hand-wheel on the shaft of which is a worm driving a worm-wheel segment *M* keyed to the shaft *N*. On this shaft a fork or arm serves as a bearing for the pivot *E*. If the handwheel is rotated the segment rotates and swings the pivot point together with the fork around the axis of shaft *N*. Thus the pivot-point *E* is moved away from or towards point *L*. By altering the distance between points *E* and *L* the swinging movement of segment *G* may be infinitely adjusted from zero to a maximum.—*February* 11, 1959.

BLAST FURNACE SLAG

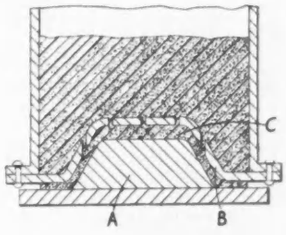
808,788. November 11, 1957.—REMOVAL OF SULPHUR FROM BLAST FURNACE SLAG, The British Oxygen Company, Ltd., Bridgewater House, Cleveland Row, St. James's, London, S.W.1. (*Inventor: Eileen Valerie Perryer.*)

It is an object of this invention to provide a method of and apparatus for the removal of sulphur from blast furnace slag by oxidation with oxygen in which the efficiency of oxygen utilisation is high and the extent of sulphur removal correspondingly great. The process comprises allowing the molten slag in the form of a number of fine streams or of a fine spray to fall through an atmosphere of oxygen. By this means, a large surface area of slag is presented to the oxygen and the efficiency of the desulphurising process and the amount of sulphur removed are thereby both greatly increased. Preferably, the molten slag is allowed to fall in countercurrent or co-current contact with a flowing stream of oxygen gas. In a preferred arrangement the molten slag is allowed to fall in the form of fine streams or a fine spray down through a hollow tower up or down which a stream of oxygen gas is passing. A tower in accordance with the invention is illustrated in the specification.—*February* 11, 1959.

SHELL MOULDING

808,364. October 14, 1955.—MANUFACTURE OF SHELL MOULDS, Bakelite, Ltd., 12, Hobart Place, London, S.W.1. (*Inventor: Frederick Bailey.*)

It is among the objects of this invention to provide a method of making a shell mould in which any desired thickness of shell may be obtained at any predetermined point; and to provide apparatus for the manufacture of a shell mould, wherein a contour plate which is used for determining the thickness of the shell is an integral part of the blowing chamber and is not removed with each pattern. The drawing



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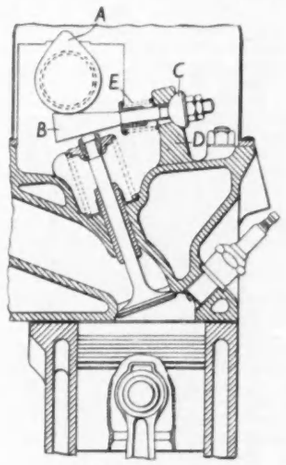
shows apparatus for making one half of a shell mould of relatively simple design. The pattern *A* is secured to a plate which can be moved upwards and downwards rapidly. The contour plate *B* is attached to the end of a cylinder which contains a resin/sand mixture. Air pressure is applied to the surface of the resin/sand mixture to force it through holes in the contour plate into the cavity between the plate and the pattern to form the shell moulding *C*. In this particular example, in which the shell moulding measures 6in by 4in and about 3in deep, it was found desirable to use an air pressure of 40 lb per square inch in order to ensure that the uncured shell had adequate strength. Immediately the moulding was formed, the pattern plate was removed with the shell still in position and placed in a curing oven. In this example it was found that the cohesion between the particles of the straight resin/sand mixture was sufficient to prevent excess powder from falling through the blow holes of the contour plate after the release of the air pressure applied for the blowing operation. The specification also describes a contour plate in which the hole is fitted with a valved diaphragm.—*February* 4, 1959.

INTERNAL COMBUSTION ENGINES

807,927. May 8, 1956.—OVERHEAD VALVE GEAR FOR INTERNAL COMBUSTION ENGINES, Austin Motor Company, Ltd., Longbridge Works, Northfield, Birmingham, and John Harold Weaving, Ph.D., of the company's address.

This invention relates to overhead valve internal combustion engines in which the valves are operated by an overhead camshaft. It is intended to provide a simple and comparatively inexpensive means for effecting valve clearance adjustments in engines of the above kind. Referring to the drawing,



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the poppet valve is loaded on to its seating by the valve spring, and is operated by a cam *A* on an overhead camshaft through the intermediary of a tappet or taper slipper *B*. The slipper spindle is slidable through a bearing member *C* in which it has pivotal movement, in a plane radial to the axis of the valve and coincident with the plane of rotation of the cam, in a complementary bearing in a mounting bracket *D* on the cylinder head. At its outer part the spindle is threaded and fitted, beyond the bearing, with an adjusting nut. A compression spring *E* between an abutment on the spindle and the mounting bracket maintains the bearing *C* in engagement with the bearing in the bracket. By adjusting the taper slipper longitudinally with the adjusting nut the operating clearance of the valve can be reduced or increased as required.—*January* 28, 1959.

METALLURGY

809,407. October 1, 1957.—PROCESS FOR ALLOYING STEEL, Union Carbide Corporation, 30, East 42nd Street, New York, United States of America.

According to the invention a process for the addition of alloying material to molten steel comprises suspending a comminuted admixture of an alloying material and an exothermic agent in an inert gas, and injecting the suspended admixture at sufficient velocity to ensure penetration of the surface of the molten steel. The ferro-alloy and exothermic agent readily dissolve in the steel with virtually no heat loss. The recovery of the alloying element in the finished steel is excellent, and the product is characterised by a uniform distribution of the alloying elements. The following example of the process is given: a mixture comprising approximately 7 per cent sodium nitrate and 3·7 per cent atomised aluminium powder as exothermic constituents, and 4·5 per cent chemical fluorspar as an accelerator, together with about 83·5 per cent medium-carbon ferromanganese was comminuted to a 0·8mm diameter average particle size, and suspended in dry nitrogen so that the weight ratio of solids to gas was 0·37. The suspension was injected into the metal in the crucible through a 1·27cm (inside diameter) graphite lance with a velocity of about 42·7m per second. Almost instantaneous solution of the material was observed as the mixture was injected into the molten metal. Analysis of the steel indicated that 87·4 per cent of the manganese was recovered in the finished steel. In the example, nitrogen was employed as the suspending and carrier gas. In practice, any gas which does not interfere with the process or which does not affect the desired purity of product is satisfactory.—*February* 25, 1959.

Launches and Trial Trips

SWAN RIVER, cargo liner ; built by the Greenock Dockyard Company, Ltd., for Houlder Brothers and Co., Ltd. ; length between perpendiculars 456ft, breadth moulded 63ft 6in, depth moulded to upper deck 39ft 4½in, deadweight 13,200 tons on 29ft 5in mean draught, service speed 13¼ knots ; five cargo holds, bale capacity 630,000 cubic feet, eight 5-ton, six 2½-ton, and two 2-ton derricks, sixteen electric winches ; three 180kW diesel-driven generators ; Hawthorn-Doxford five-cylinder oil engine, 5500 b.h.p. at 115 r.p.m. Launch, December 2.

KING HENRY, cargo ship ; built at Belfast by Harland and Wolff, Ltd., for the King Line, Ltd. ; length between perpendiculars 435ft, breadth moulded 59ft, depth moulded to shelter deck 39ft 9in ; two complete steel decks, five cargo holds, one 50-ton, one 25-ton, six 10-ton, and six 5-ton derricks ; three 125kW diesel-driven generators ; Harland and Wolff-B. and W. single-acting, four stroke, diesel engine, six cylinders, 740mm diameter by 1500mm stroke, 115 r.p.m. Trial, December 5.

STANCLOUD, oil tanker ; built at the Neptune works of Swan, Hunter and Wigham Richardson, Ltd., for the Stanhope Steamship Company, Ltd. ; length between perpendiculars 535ft, breadth moulded 71ft 8in, depth moulded 40ft, summer draught 29ft 6in, deadweight 18,750 tons ; thirty cargo oil tanks, one cargo oil pump room, three 550 tons per hour oil cargo pumps, two stripping pumps, two 245kW diesel-driven generators and one 75kW steam-driven generator ; Swan, Hunter-Doxford diaphragm oil engine, six cylinders, 725mm diameter by 2250mm combined stroke, arranged to burn boiler fuel, 7500 b.h.p. at 115 r.p.m. Trial, December 11.

TEAKBANK, cargo liner ; built by William Doxford and Sons (Shipbuilders), Ltd., for the Bank Line, Ltd. ; length between perpendiculars 450ft, breadth moulded 62ft, depth moulded to upper deck 38ft 6in, deadweight 12,160 tons on closed shelter deck draught, one 25-ton, four 10-ton and ten 5-ton derricks, serving five holds ; Doxford opposed piston oil engine, four cylinders, 700mm diameter by 2320mm combined stroke, 4800 b.h.p. Trial, December 29.

MAORI, cargo ship ; built by the Chantiers Navals de La Ciotat for the Compagnie des Messageries Maritimes ; length between perpendiculars 479ft, breadth moulded 64ft 8in, depth to shelter deck 38ft 0½in, draught loaded 25ft 11in, bale capacity 530,000 cubic feet ; Sulzer mark 10RS.AD76 diesel engine, 13,700 h.p. at 120 r.p.m., service speed 19·5 knots. Trial, December.

TOCANSA, cargo ship ; built by the Chantiers Réunis Loire-Normandie for the Compagnie des Transports Oceaniques ; length between perpendiculars 446ft 2¾in, breadth moulded 62ft 5in, depth to shelter deck 36ft 9in, bale capacity 494,000 cubic feet, service speed 16 knots ; Creusot-B. and W. supercharged mark 774VTBF.160 diesel engine, 7500 b.h.p. at 115 r.p.m. Trial, December.

MARYLAND, closed shelter deck cargo ship ; built by the Ateliers et Chantiers de Provence for the Compagnie Générale Transatlantique ; twelve passengers ; length between perpendiculars 457ft 8in, breadth moulded 61ft 8in, depth to upper deck 39ft 0¾in, draught loaded 26ft 11in, deadweight 9600 tons, bale capacity 554,000 cubic feet ; five holds, one 30-ton, one 20-ton, also 10-ton and 5-ton derricks ; Ermans and Mège hatch covers ; three 350kW generators ; Provence-Doxford six-cylinder oil engine, 9000 b.h.p. at 120 r.p.m., service speed 16 knots. Trial, December.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

To-day, March 20.—STOKE AND CREWE BRANCH : Grand Hotel, Hanley, "Cable Insulation," 7.30 p.m.
Sat., March 21.—YORK BRANCH : Visit to the Coal Carbonisation Plant, Askern Colliery, Doncaster, 10.30 a.m.
Tues., March 24.—LONDON NATIONAL LECTURE : Lecture Theatre, Institution of Electrical Engineers, Savoy Place, London, W.C.2, "New Materials, Methods and Techniques in Electrical Engineering," H. G. Taylor, 6.30 p.m. ★ TYNESIDE BRANCH : Crown Hotel, Newcastle, Films, 7.30 p.m.
Thurs., March 26.—BRIGHTON, HOVE AND DISTRICT BRANCH : New Imperial Hotel, First Avenue, Hove, "Floor Warming," D. J. Hunt, 7.30 p.m. ★ SOUTH LONDON BRANCH : Greyhound Hotel, High Street, Croydon, "Safety in the Uses of Electricity," S. J. Emerson, 8 p.m.

BRITISH INSTITUTE OF MANAGEMENT

Tues., March 24.—PRODUCTION CONTROL STUDY GROUP : Management House, Fetter Lane, London, E.C.4, "Pre-Production Planning Stages," H. Bud, 2.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

To-day, March 20.—SCOTTISH SECTION : Department of Natural Philosophy, The University, Drummond Street, Edinburgh, "Application of Magnetic Amplifiers to Electrical Switching," J. A. Purdie, 7 p.m.
Tues., March 24.—SOUTH WESTERN SECTION : School of Management Studies, Unity Street, Bristol, 1, "Recent Advances in Travelling Wave Tubes," P. F. C. Burke, 7 p.m.
Wed., March 25.—London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, Symposium on "Radio Telemetry," 3 p.m., and 6.30 p.m.

COMBUSTION ENGINEERING ASSOCIATION

Tues., March 24.—SOUTHERN REGION : St. Ermins Hotel, Westminster, London, S.W.1, "The Costing of Heat and Power," G. H. Buckle, 10.30 a.m. ; "Capital Investment and Fuel Saving Schemes," R. H. Potterill, 2.30 p.m.

ILLUMINATING ENGINEERING SOCIETY

To-day, March 20.—BIRMINGHAM CENTRE : St. Mary's Hall, Coventry, "Architecture of Light," Rolf Helburg, 6 p.m.
Tues., March 24.—LEEDS CENTRE : Institute of Technology, Bradford, Joint Meeting with the Institution of Electrical Engineers, "Fifty Years of Lighting Development," J. W. Howell, 6.45 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

Wed., March 25.—Constitutional Club, Northumberland Avenue, London, W.C.2, "Some Aspects of Small Foundry Practice," F. P. Robinson, 7.30 p.m.

INSTITUTE OF FUEL

Tues., March 24.—SCOTTISH SECTION : Royal College of Science and Technology, Glasgow, Annual General Meeting ; "Trend of Coal Production in Scotland over next Ten Years," A. Thomson, 7 p.m. ★ MIDLAND SECTION : Lecture Hall, back Glebe Street, Stoke-on-Trent, "Methane Drainage," D. C. Yates, 7 p.m.
Wed., March 25.—LONDON SECTION : Institution of Civil Engineers, Great George Street, London, S.W.1, "Investigational Work Carried Out by the National Coal Board's Scientific Control Organization," D. Hicks, 5.30 p.m. ★ YORKSHIRE SECTION : Metropole Hotel, Leeds, Annual General Meeting, 2.30 p.m.
Thurs., March 26.—MIDLAND SECTION : Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, 2, "Coal Marketing and Associated Problems," R. A. Howson, 6.30 p.m.

INSTITUTE OF MARINE ENGINEERS

To-day, March 20.—MERSEYSIDE AND NORTH WESTERN SECTION : The John Whinnerah Institute, Barrow-in-Furness, Joint Meeting with the Barrow Association of Engineers, "Metallurgy in Marine Engineering," J. E. Garside, 7.30 p.m.

INSTITUTE OF NAVIGATION

To-day, March 20.—Royal Geographical Society, 1, Kensington Gore, London, S.W.7, "The Impact of Radar on the Rules of the Road at Sea," F. J. Wylie, 5.15 p.m.

INSTITUTE OF PETROLEUM

Thurs., March 26.—LONDON BRANCH : 61, New Cavendish Street, London, W.1, "The Purpose of Additives in Modern Gasolines," C. G. Tresidder, 6 p.m.

INSTITUTION OF CIVIL ENGINEERS

To-day, March 20.—1, Birdcage Walk, Westminster, London, S.W.1, Joint Meeting with the Institutions of Mechanical Engineers and Electrical Engineers, Graham Clark Lecture, "Engineering in an Expanding Economy," Professor Sir Arnold Plant, 6 p.m.
Thurs., March 26.—NORTH WESTERN ASSOCIATION : Queen Hotel, Chester, "Investigations of Navigation and Bridging Problems of the River Dee," J. A. L. Matheson, 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

To-day, March 20.—FIFTH GRAHAM CLARK LECTURE : Institution of Mechanical Engineers, 1, Birdcage Walk, Westminster, London, S.W.1, Joint Meeting with the Institutions of Mechanical Engineers and the Civil Engineers, "Engineering in an Expanding Economy," Professor Sir Arnold Plant, 6 p.m.
Mon., March 23.—RADIO AND TELECOMMUNICATION SECTION : Lecture Theatre, Savoy Place, London, W.C.2, "High-Quality Microphones," M. L. Gayford ; Tea Room, Savoy Place, London, W.C.2, "Effects of Argon Content on the Characteristics of Neon-Argon Glow-Discharge Reference Tubes," F. A. Benson, 5.30 p.m. ★ NORTH-EASTERN CENTRE : Neville Hall, Westgate Road, Newcastle upon Tyne, "The Selection of Insulation Levels and Tests for High-Voltage Transformers," G. B. Harper, 6.15 p.m. ★ SOUTH MIDLAND RADIO AND MEASUREMENT GROUP : James Watt Memorial Institute, Birmingham, "The History of B.B.C. Television," R. T. B. Wynn, 6 p.m. ★ WESTERN UTILIZATION GROUP : South Wales Institute of Engineers, Park Place, Cardiff, Informal Meeting, 6 p.m.
Tues., March 24.—NORTH MIDLAND CENTRE : Institute of Technology, Bradford, Joint Meeting with the Illuminating Engineering Society, "Fifty Years of Lighting Development (1909–1959)," J. W. Howell, 6.45 p.m. ★ NORTH-WESTERN MEASUREMENT AND CONTROL GROUP : Engineers' Club, Albert Square, Manchester, "Some Recent Researches into the Problems Associated with the Bottom Bearings of Electricity Meters," G. F. Shotter, 6.15 p.m.
Wed., March 25.—SUPPLY SECTION : Savoy Place, London, W.C.2, "The Selection of Insulation Levels and Tests for High-Voltage Transformers," G. B. Harper, 5.30 p.m. ★ SOUTH-WEST SCOTLAND SUB-CENTRE : Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "Thermonuclear Fusion and the Development of Zeta," E. R. Hartill, 7 p.m.

INSTITUTION OF ENGINEERING DESIGNERS

Tues., March 24.—YORKSHIRE BRANCH : Midland Hotel, Bradford, "Machinery and Processes Involved in Carpet Making," N. K. Earle, 7.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

To-day, March 20.—Robert Gordon's Technical College, Aberdeen, Joint Meeting with Aberdeen Mechanical Society, "Resistance and Propulsion of Single-Screw Coasters, Part IV, L/B = 5½," J. Dawson, 7.45 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, March 20.—GRAHAM CLARK LECTURE : 1, Birdcage Walk, Westminster, London, S.W.1, Joint Meeting with the Institutions of Electrical Engineers and Civil Engineers, "Engineering in an Expanding Economy," Professor Sir Arnold Plant, 6 p.m.
Sat., March 21.—WESTERN GRADUATES' SECTION : Visit to Williams and James, Chequers Bridge, 10.30 a.m.
Mon., March 23.—DERBY A.D. CENTRE : Rolls-Royce Welfare Hall, Derby, "The Petroleum Industry's Role in World Car Market Development," K. E. W. Ridler, 6.15 p.m.
Tues., March 24.—STEAM GROUP : 1, Birdcage Walk, Westminster, London, S.W.1, Discussion on "British Standard No. 1113: Water Tube Boilers and their Integral Superheaters," 6 p.m. ★ EASTERN BRANCH : Dujon Restaurant, Bedford, "Management Control of Small Engineering Firms," L. Fontaine, W. R. Spencer and J. W. Walker, 7.30 p.m.
★ NORTH WESTERN BRANCH (LIVERPOOL PANEL) : Blossoms Hotel, Chester, "Design and Development of Four Light-Weight High-Speed Marine Gas Turbines," A. W. Pope, 6.45 p.m. ★ BIRMINGHAM A.D. CENTRE : College of Technology, Wulfruna Street, Wolverhampton, "Lubrication Problems in Small Two-Stroke Engines," A. Towle, 7.30 p.m. ★ WESTERN A.D. CENTRE : Royal Hotel, Bristol, "Recent Developments in the Manufacture of Castings," P. A. Russell and J. L. Rice, 6.45 p.m. ★ LONDON GRADUATES' SECTION : Visit to Kodak, Ltd., Wealdstone, Harrow, Middlesex, 2 p.m. ★ MIDLAND A.D. CENTRE : Evening visit to B.B.C. Television Studios, Gosta Green, Birmingham.
Wed., March 25.—LUBRICATION GROUP : 1, Birdcage Walk, Westminster, London, S.W.1, Discussion on "Problems of Lubrication at High Temperatures," 6 p.m. ★ EAST MIDLANDS BRANCH : Room C.4, Engineering Building, The University, Nottingham, "Application of Electronic Techniques to Machine Tool Control," H. A. Prime, 7.15 p.m.

INSTITUTION OF NAVAL ARCHITECTS

Tues. to Thurs., March 24 *to* 26.—Weir Lecture Hall, 10, Upper Belgrave Street, London, S.W.1, Spring Meeting ; *Tues.*—Annual General Meeting ; "Some Thoughts on Dry-docks," T. Eustace Smith, 10.15 a.m. ; *Wed.*—"Train and Car Ferries," J. P. Campbell ; "Container Ships," D. A. Argyriadis, 10.15 a.m. ; "Re-Analysis of Ship Model Correlation Data Using the 1957 I.T.T.C. Line," R. E. Clements ; "A Further Study of Ship Losses," C. V. Manley, 2.30 p.m. ; *Thurs.*—"Standard of Stability Adopted in Japan," M. Yamagata ; "Tonnage Measurement," L. Cristiani, 10.15 a.m.

INSTITUTION OF PLANT ENGINEERS

To-day, March 20.—BIRMINGHAM BRANCH : Imperial Hotel, Temple Street, Birmingham, Annual General Meeting ; Films, 7.30 p.m.
Mon., March 23.—WEST AND EAST YORKSHIRE BRANCH : Fuel Department Lecture Threatre, New Building, The University, Leeds, Annual General Meeting, 7.30 p.m.
Tues., March 24.—WESTERN BRANCH : Grand Hotel, Broad Street, Bristol, Annual General Meeting, 7.15 p.m.
Thurs., March 26.—BLACKBURN BRANCH : White Bull Hotel, Blackburn, Annual General Meeting, 7.30 p.m. ★ SHEFFIELD BRANCH : Grand Hotel, Sheffield, "Refractories," T. R. Lynam, 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

To-day, March 20.—WALES REGION : S. Wales Institute of Engineers, Park Place, Cardiff, Annual General Meeting, 7 p.m. ; "Engineering Ceramics," C. G. Martin, 7.30 p.m.
Mon., March 23.—NORTH MIDLANDS REGION : Louis Room, St. James's Restaurant, St. James's Street, Derby, Annual General Meeting ; Film Show, 7 p.m.
Tues., March 24.—NORTH WESTERN REGION : Exchange Hotel, Tithebarn Street, Liverpool, 2, Annual General Meeting ; Film, 7.30 p.m. ★ NORTH WESTERN REGION : Reynold's Hall, Manchester College of Science and Technology, Sackville Street, Manchester, Annual General Meeting ; "Machining of Uranium, Thorium, Niobium, Vanadium, Zirconium and Beryllium," A. Piggott, 6.30 p.m.
Wed., March 25.—MIDLANDS REGION : Technical College, Abbey Foregate, Shrewsbury, Annual General Meeting, 6.45 p.m. ; Film Show, 7.30 p.m. ★ MIDLANDS REGION : Star Hotel, Worcester, Annual General Meeting ; "Numerical Control of Machine Tools," O. S. Puckle, 7 p.m.
Thurs., March 26.—WOLVERHAMPTON GRADUATE SECTION : Evening Visit to Fischer Bearing Company, Villiers Street, Wolverhampton. ★ ROCHESTER AND DISTRICT GRADUATE SECTION : Old Palace, Maidstone, Kent, "Casting Design with Particular Reference to High Duty Irons," D. F. Knight, 7.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Tues., March 24.—WALES AND MONMOUTHSHIRE BRANCH : South Wales Institute of Engineers, Cardiff, "Plate Girder Design," K. C. Rockey, 6.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS

To-day, March 20.—Engineers' Club, Albert Square, Manchester, Annual General Meeting, "Production Investigations Applied in Practice," N. Dudley and F. Koenigsberger, 6.45 p.m.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

Mon., March 23.—Lecture Theatre, Mining Institute, Neville Hall, Newcastle upon Tyne, "The Thermal and Elastic Properties of Eight Cast Irons," D. Fitzgeorge and J. A. Pope ; "An Investigation into the Creep Properties of Two Cast Irons," C. Wheatley and J. A. Pope, 6.15 p.m.

PHYSICAL SOCIETY

Tues., March 24.—ACOUSTICS GROUP : Physics Department, Imperial College, Imperial Institute Road, London, S.W.7, Symposium on "Recent Studies of Noise Problems," 2.15 p.m. ; Annual General Meeting, 5.30 p.m.

PLASTICS INSTITUTE

To-day, March 20.—MIDLANDS SECTION : James Watt Memorial Institute, Great Charles Street, Birmingham, "Plastics in the Motor Industry," F. C. Watkins, 6.30 p.m.

REINFORCED CONCRETE ASSOCIATION

Tues., March 24.—SCOTTISH BRANCH : North British Hotel, Edinburgh, "Multi-Storey Flat Development in Birmingham," J. R. Sheridan-Shedden, 6.30 p.m.

ROYAL STATISTICAL SOCIETY

Thurs., March 26.—LEICESTER GROUP : Room 104, Leicester College of Technology, The Newarke, Leicester, Annual General Meeting ; Quiz Programme, 7 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY

To-day, March 20.—SCOTTISH SECTION : Scottish Building Centre, 425, Sauchiehall Street, Glasgow, Annual General Meeting, 7.15 p.m.
Tues., March 24.—CONTROL SECTION : Manson House, Portland Place, London, W.1, "New Directions in Engineering Psychology," R. Conrad, 5.30 p.m.
Wed., March 25.—CHESTER SECTION : Lecture Theatre, Grosvenor Museum, Grosvenor Street, Chester, "Industrial Applications of Transistors," D. G. Holloway, 7 p.m. ★ SOUTH WALES SECTION : Physics Lecture Theatre, Welsh College of Advanced Technology, Cardiff, Annual General Meeting ; "The Instrumentation of a Nuclear Power Station," K. R. Sandiford, 6.45 p.m.

SOCIETY FOR WATER TREATMENT AND EXAMINATION

To-day, March 20.—Library, Royal Society of Health, 90, Buckingham Palace Road, London, S.W.1, Annual General Meeting ; "Cathodic Protection," P. V. Palmer, "Microbiological Examination of Water in Dairies and Food Factories," J. G. Davies, and Symposium on "Colour and Its Measurement with Special Reference to Water Analysis," G. J. Chamberlin and A. A. Christie, 9.30 a.m.

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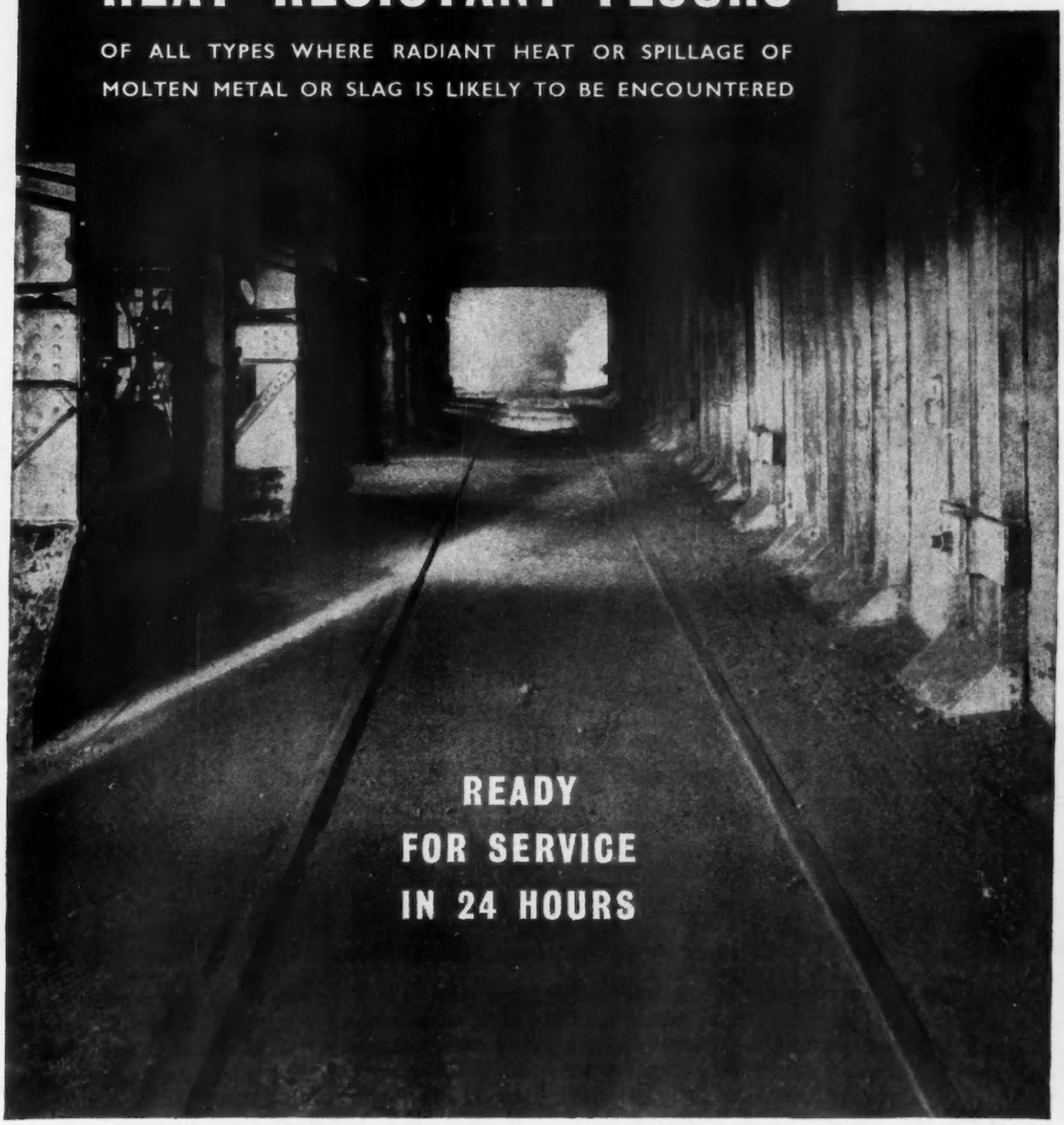

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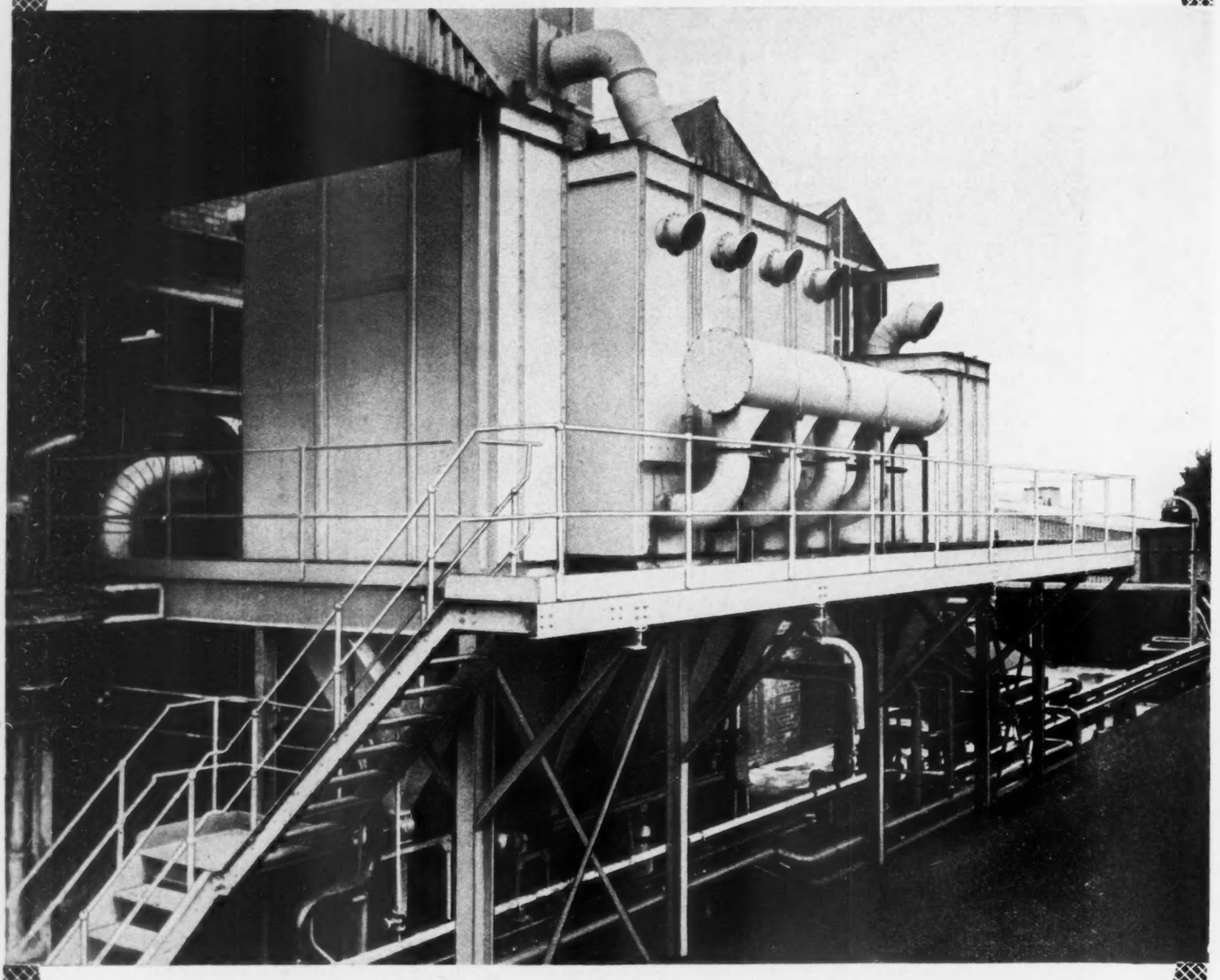

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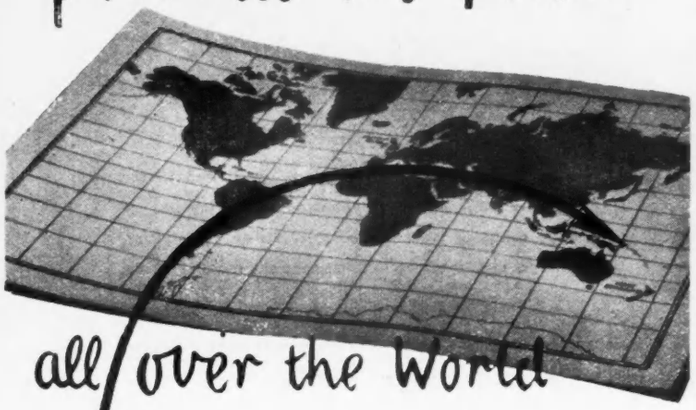

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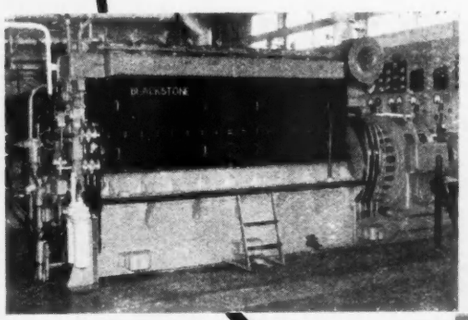

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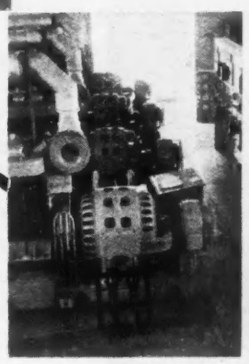

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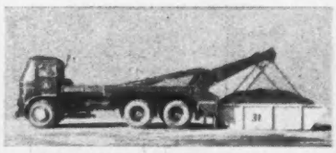
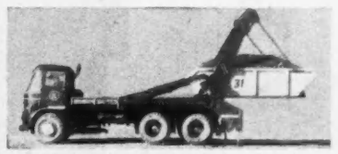


Rear independent hydraulic stabilizer jacks down. Load to be raised to Unit Deck.



Showing load being raised by retraction of hydraulically operated lifting arm rams.

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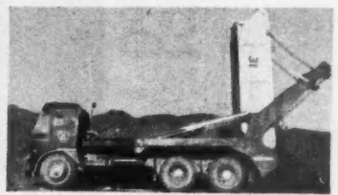

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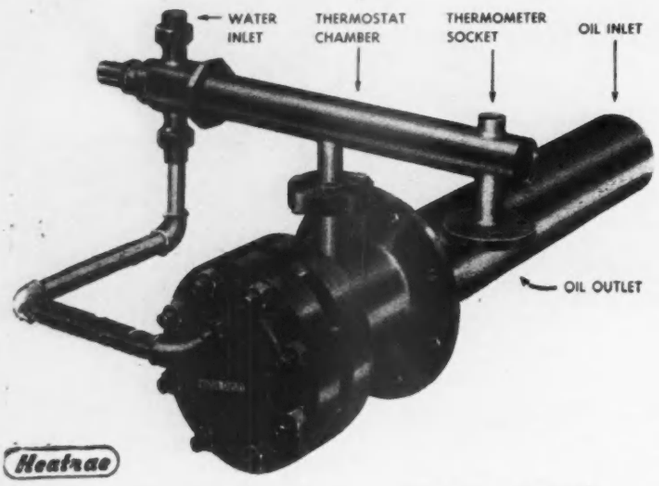

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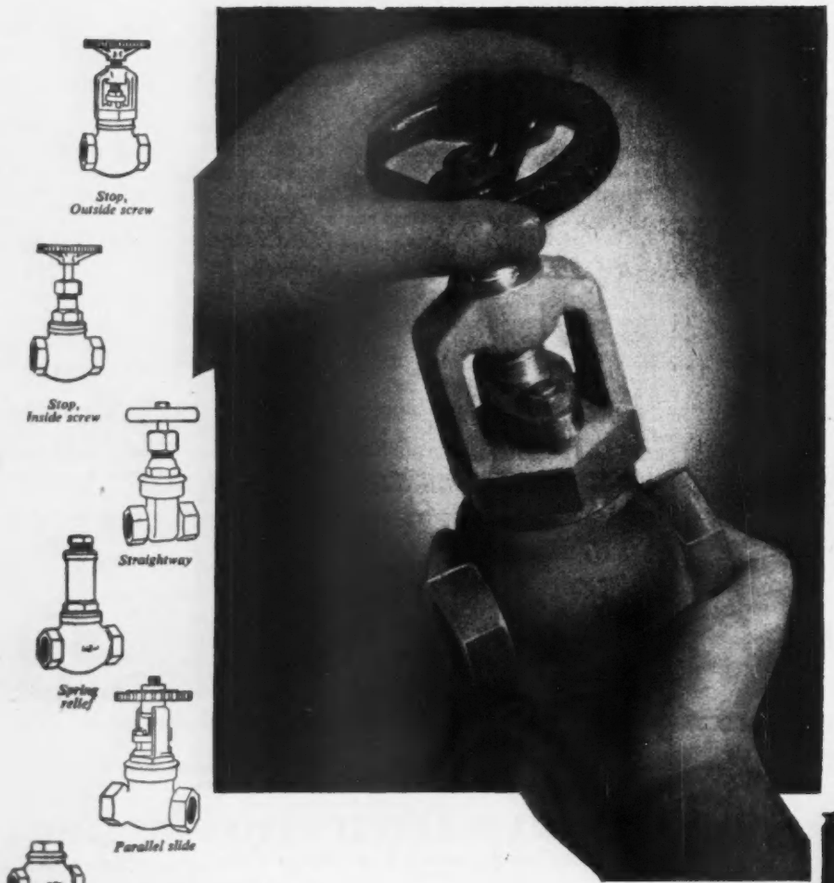

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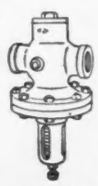

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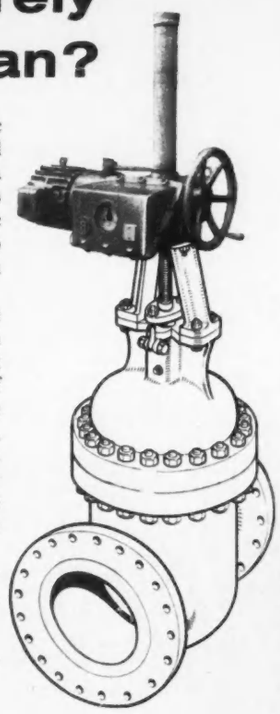

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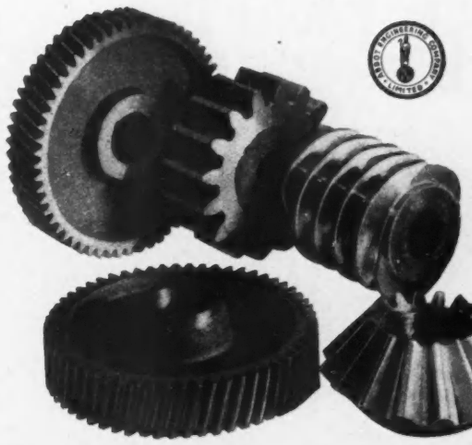

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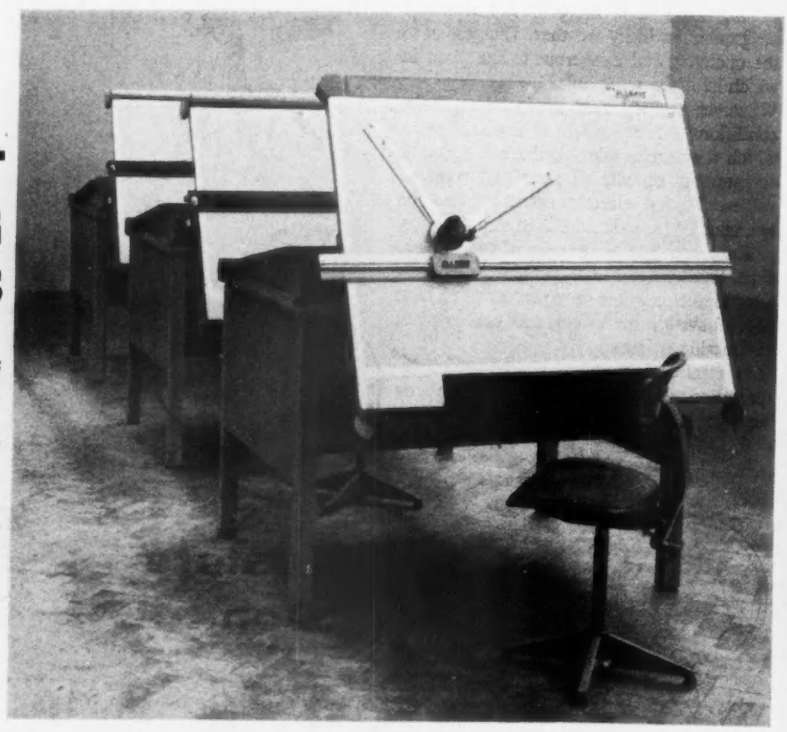

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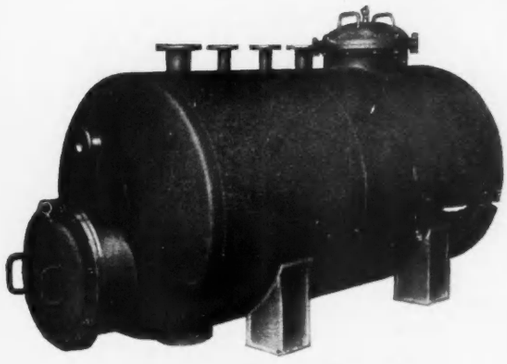

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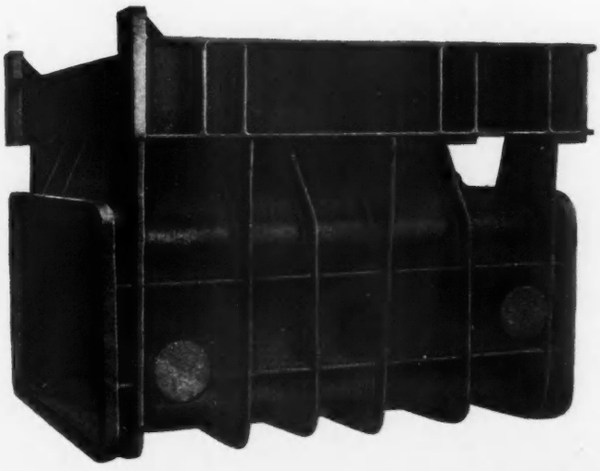
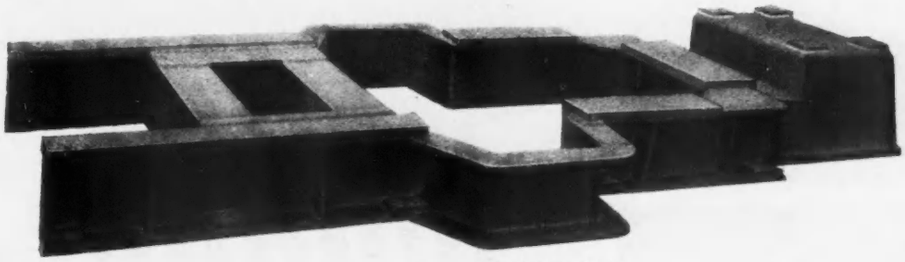
We manufacture a large variety of Vessels in Mild Steel or Aluminium Alloys, for all purposes. Vessels with special linings can also be supplied either homogeneous lead or rubber-lined. Mechanical stirrers or paddles can be incorporated to customers' requirements.



SPECIAL FABRICATIONS

Intricate shapes such as Condenser Cases are the outcome of our many years' fabrication experience and by producing clean finished parts requiring no machining, we can supply a structure with clean lines and minimum distortion.



BEDPLATES

We can supply Bedplates for machinery, fabricated to all types of designs. Such structures are free from distortion, rigid and indestructible, and show a great saving in weight over other types. All necessary machining can also be carried out.

Our latest Brochure "FABRICATED PLATEWORK" fully describes our activities in this field. A copy is yours on request.

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AVERY have their own fool-proof method of dealing with the harmful effects of out-of-balance in rotating parts. Oscillation measurements (a) quickly determine the variation from uniform mass distribution about the fixed axis of rotation (b) bring these variations together into measuring planes, and (c) show them in components, or as a vector value.

But each rotor has its own individual characteristics. Every one must be considered as a separate entity in terms of weight, diameter, compensation planes, etc. When in motion (remember, you can't detect out-of-balance in a static work-piece) other all-important factors are involved; the best form of drive, correct speed, appropriate bearings . . . .

Only a dynamic balancing programme which meets all these requirements can be considered adequate to deal with any one specific work-piece. AVERY have perfected just such a programme . . . . a whole range of machines to suit any type of component. Whatever your particular problem in this field, AVERY has the answer. Send for illustrated booklet No. DB 591 or write to the address below.

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IRON-ORE CONVEYING

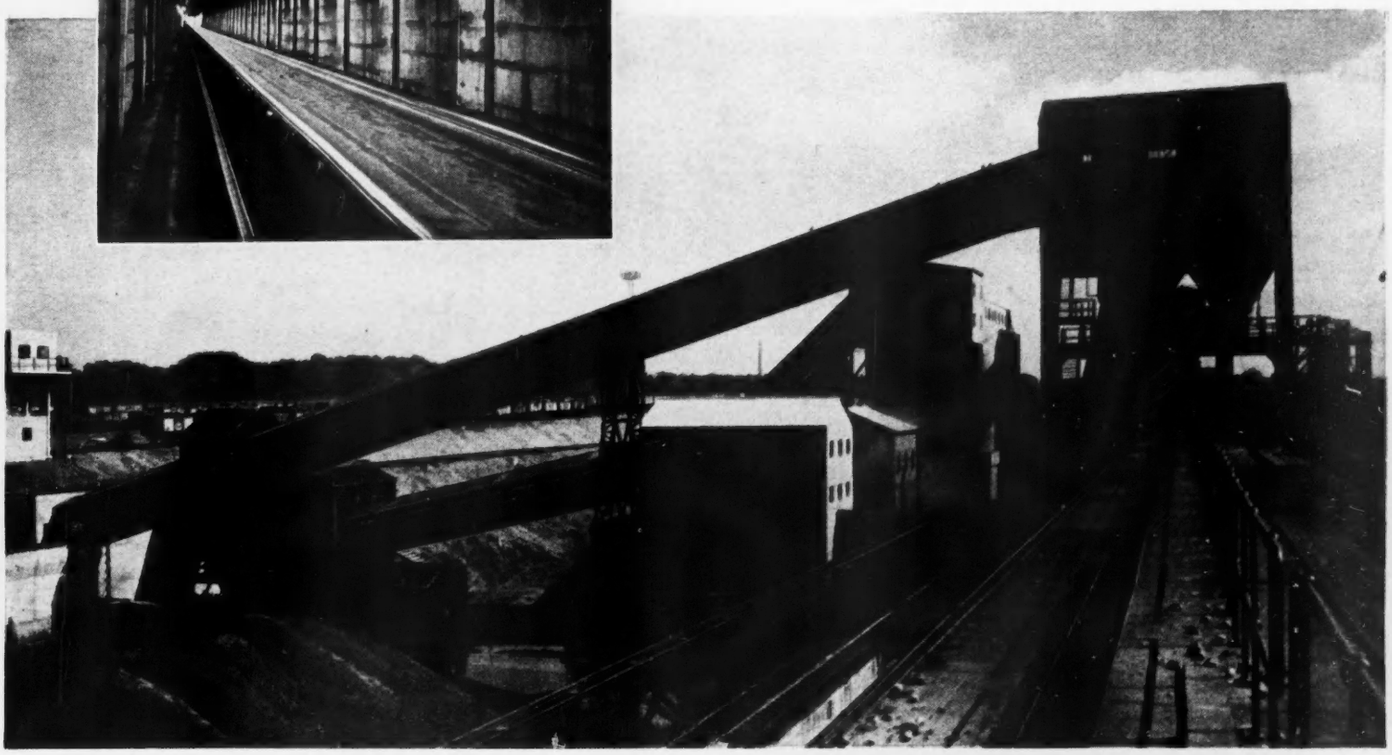
A 940 tons per hour system is typical

The handling of iron-ore at the rate of 940 tons per hour in one of Britain's larger steelworks is a typical example of projects with which Richard Sutcliffe are used to being associated.

The Company have developed the use of conveyor systems for almost every Industry where raw materials must be handled in bulk. Specifically designed for the job in hand, there is a Sutcliffe conveyor to suit every proposition.

A 60" wide Conveyor installation at Messrs. John Summers Ltd.

Iron-ore conveyor system at Messrs. Colvilles new plant at Ravenscraig.



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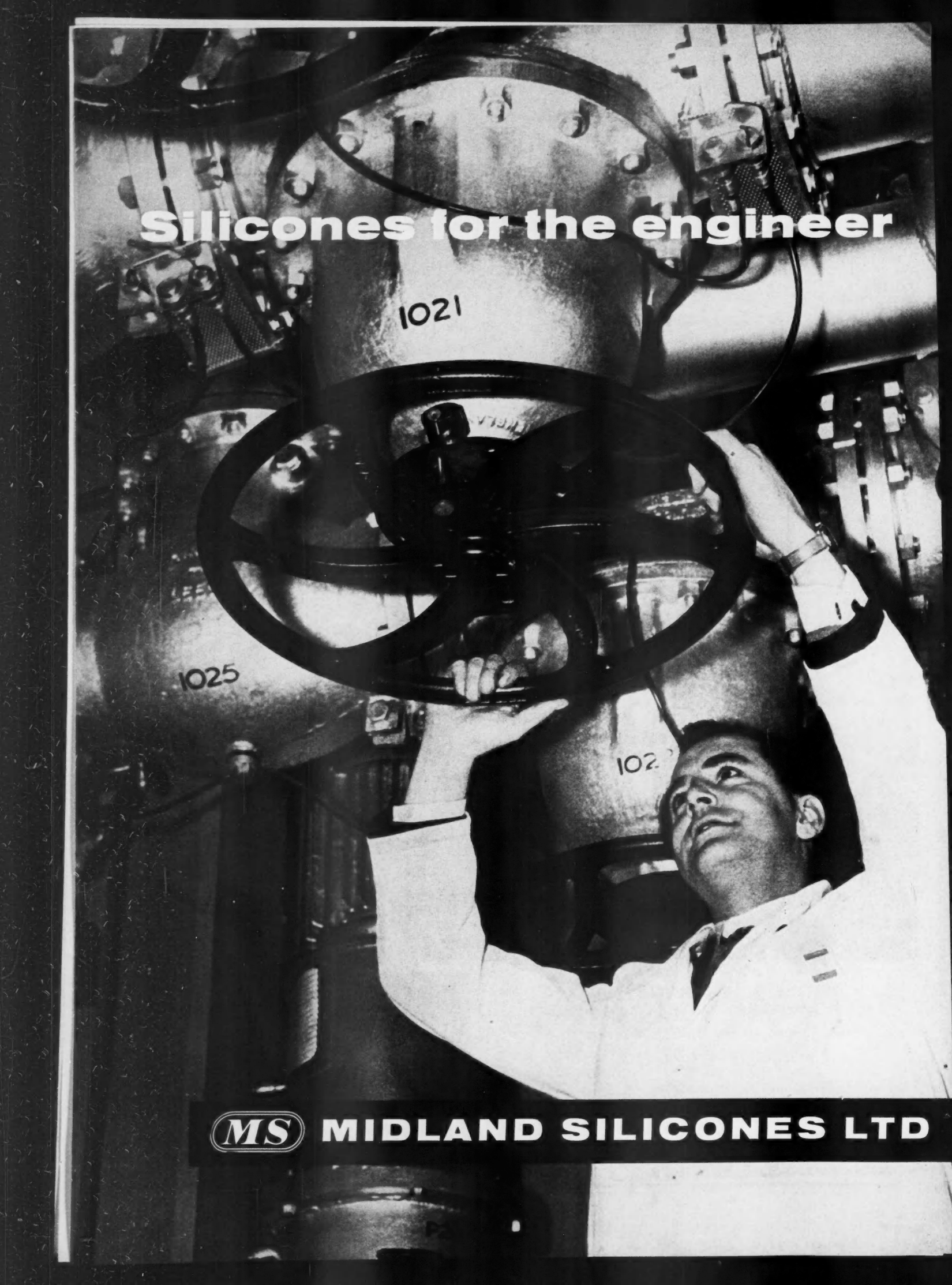
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MS

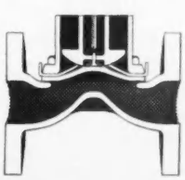
*Silastomer silicone rubber withstands temperature extremes

Because of their excellent temperature stability diaphragms of Silastomer silicone rubber are used in many of the various types of valves manufactured by Saunders Valve Co. Ltd. Silastomer will remain serviceable at temperatures as low as −70°C, where other rubbers harden and become brittle, and as high as +250°C, where organic rubbers char and decompose. Silastomer is also resistant to a wide range of chemicals.

Apart from their use as valve diaphragms Silastomer silicone rubbers have many applications as seals and gaskets which must remain durably resilient at elevated temperatures. Grades are available to resist petrol, lubricating and hydraulic oils. Silastomer is also used in paste form as a high temperature caulking and sealing compound and can be coated on to glasscloth for use as heat resistant sleeving, ducting and diaphragms.

The photograph shows one of the many types of Saunders Valves in use in industry.
BY COURTESY OF SAUNDERS VALVE CO. LTD.

The sectional view shows the resilient diaphragm in the Saunders Valve. The excellent temperature stability of silicone rubber diaphragms enables these valves to be used for conveying gases and chemicals at extremes of temperature.



* SILASTOMER IS A REGISTERED TRADEMARK OF MIDLAND SILICONES LTD.

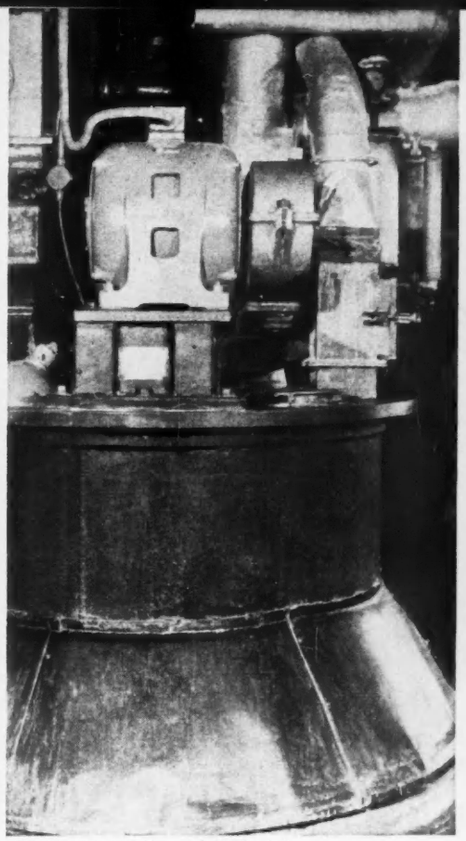


Photo by courtesy of Thomas Hedley Co. Ltd.

MS

Silicone motor rewind saves £400

Thomas Hedley & Co. Ltd., at the company's West Thurrock factory, found that one of their motors working in a particularly wet position, on a mixing tank used in the manufacture of synthetic detergents, broke down at average intervals of 6 months. Rewinds were tried in Class A insulation (costing £30 each time), and in Class B insulation with extra varnish dips to give additional protection against moisture – both without success. Finally they tried a silicone rewind. This was nearly seven years ago and the motor has been operating since without failure, thus saving approximately £400 in rewind costs. In addition losses in production time due to motor failure have been eliminated.

MS silicones strengthen the weak link in all forms of electrical equipment – its insulation. With silicone-insulated motors the risk of breakdown through insulation failure is very greatly reduced. Have your most troublesome motors rewound with silicone insulation. Write to Midland Silicones for names of rewinders with experience in using silicone insulation.

MS

Antifoam kills foam –boosts output

Kill foam and increase the productive capacity of machine tools with a highly efficient MS silicone defoamer. The water and oil coolants used in the heavy-duty grinders shown in the photograph foamed so badly that it was necessary to shut the machine down for 15 minutes of every hour just to clear foam away. Conventional foam inhibitors were partially effective, but reduced the efficiency of the coolant.

A silicone antifoam agent was added to the coolant and foam vanished immediately – "like a punctured balloon" – and hourly grinder output increased 25%.

MS silicone defoamers are effective in low concentrations making them most economical in use. They will remain stable for long periods in either hot or cold storage conditions.

There is an MS silicone antifoam agent in the form of a compound, fluid or emulsion to deal with your particular foaming problem.

First in British Silicones

Write for full information about these and the many other silicone products with applications in the engineering industry ineluding release agents, damping and hydraulic fluids, heat-resistant paint, resins, lubricants and electrical insulants.

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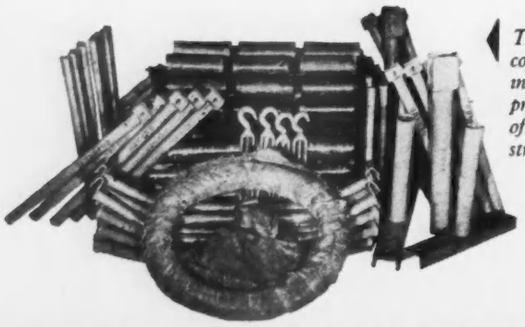
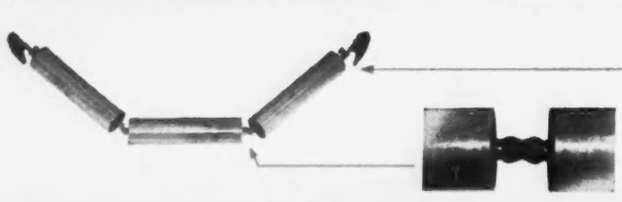
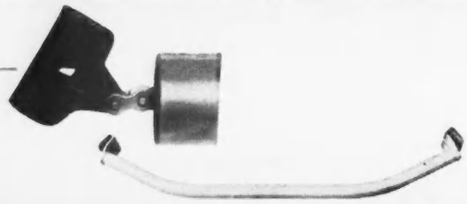


This group of components—stacked in an area of 28 sq. ft.—produce 200 ft. *of this conveyor structure . . . .*

DISTINGTON-GOODMAN ROPE BELT CONVEYOR STRUCTURE patented



swivel links are fitted at each end of an idler shaft

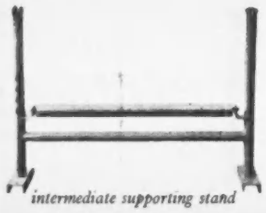


stretchers are used at intervals between stands

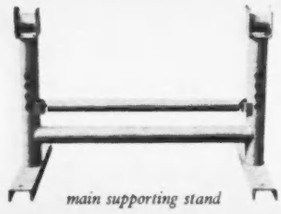
RESILIENT

- *increases belt life*
- *reduces installation costs*
- *increases capacity*
- *almost eliminates spillage*
- *inexpensive*

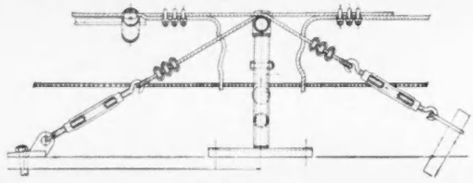
wire rope 1" dia. and 6 x 19 regular lay



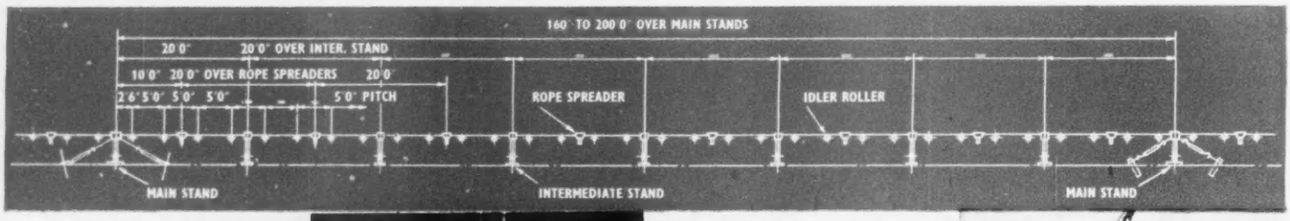
intermediate supporting stand



main supporting stand

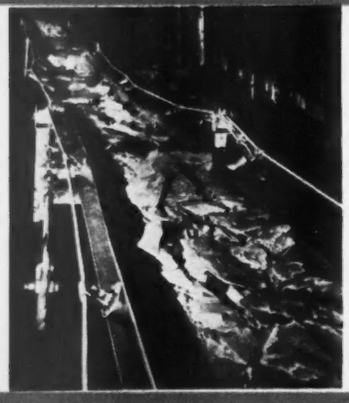


typical rope anchorages



Installation, extension and contraction of Distington-Goodman Rope Belt Conveyor Structure is relatively quick and easy.

(Right) Detail of a main stand and anchor point. These can be spaced up to 400' apart according to requirements.



A 36" rope belt conveyor installed at a quarry, carrying 500 tons of gravel per hour. By securing the rope to terminal pulleys it has proved practicable to move this conveyor bodily sideways by the dragline shown in the illustration.

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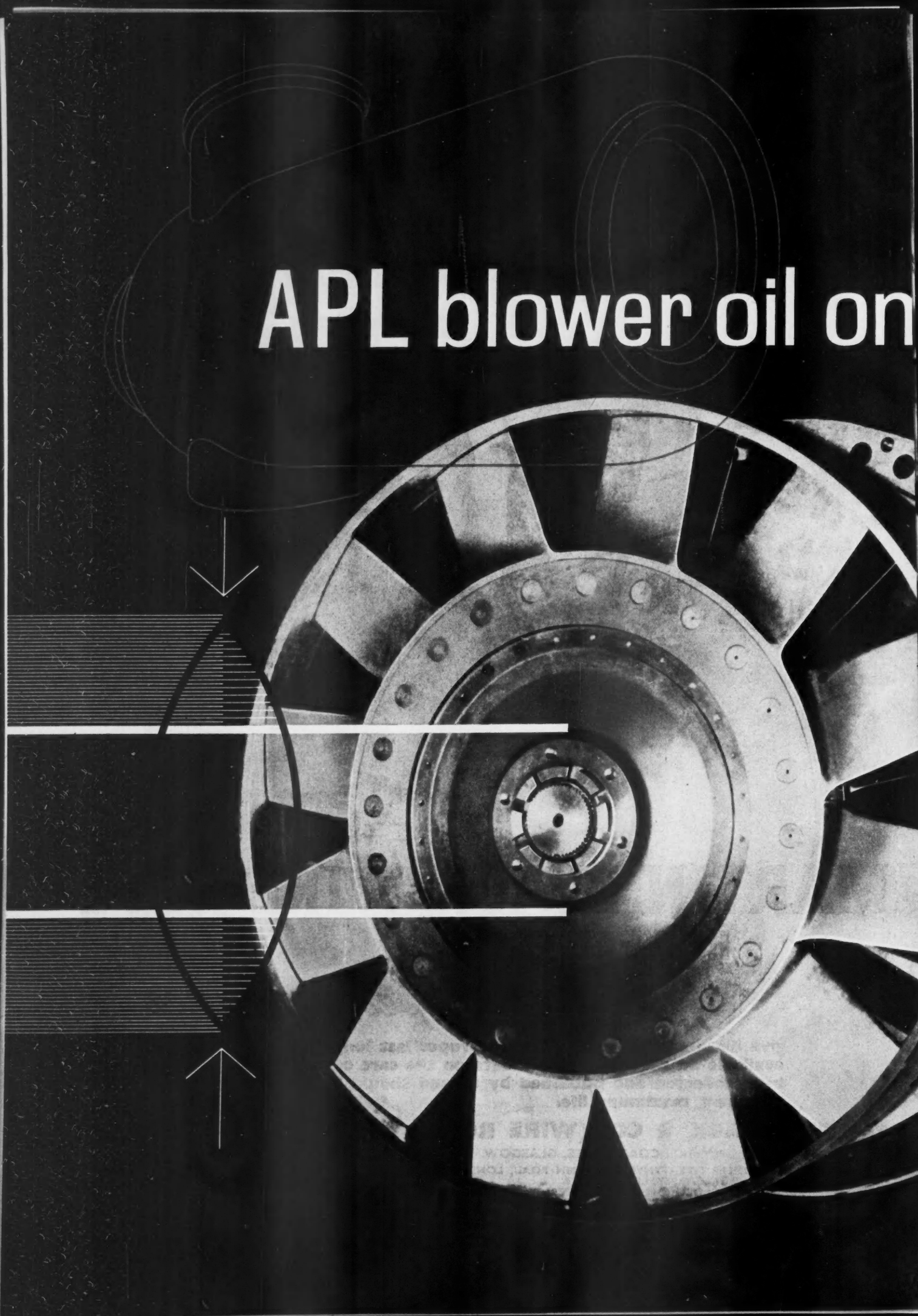
APL blower oil on



sentry-go at Bradwell...

The crucial points of the high pressure CO_2 coolant circuit at Bradwell will be the blower shaft seals. Every minute of every working day Shell APL blower oil will guard these escape points—being continually pumped into the seals and bearings, led away, purified and recirculated.

This very remarkable oil presents a two-way seal. Outwards, there is a minimum CO_2 loss as the oil has the lowest possible gas solubility. Inwards, in spite of the heat of the gas, oil vapour contamination is negligible thanks to the extremely low vapour pressure of the oil.

The research that went into APL blower oil is characteristic of the way Shell set about doing things. It was conducted at Shell's Research Centre at Thornton in close collaboration with the U.K. A.E.A. and the blower manufacturers. In the course of much fundamental research, a wide range of oils was subjected to vapour pressure and gas solubility tests in the laboratory. Selected oils from this range were used in the bearings and seals of a blower rig. In 1956, after four years of research, the finished product joined the Shell Atomic Power Lubricants range—marketed under the name of Shell APL 729. This oil has been in use at Calder Hall since the autumn of 1956.

The moral of the story is that Shell research is supremely applicational. The Centre at Thornton is always ready to work with even the most specialised sectors of industry to produce the right oil for the job. If you and your organisation have any major lubrication problem it pays to get in touch with your local distributor of Shell Industrial Lubricants.

The Research Story

Though the sealing action demanded of Shell blower oil is common in other industrial equipment such as hydrogen-cooled alternators, there were quite a few additional problems. It was necessary for the oil to have long life, low vapour pressure, low gas solubility, good thermal stability and high film strength —to be able to withstand high temperatures and to be resistant to all kinds of corrosive influences, including carbonic acid. The crux of the research was to combine all the above requirements into one oil, in order to minimise back diffusion of molecules which would contaminate the reactor.

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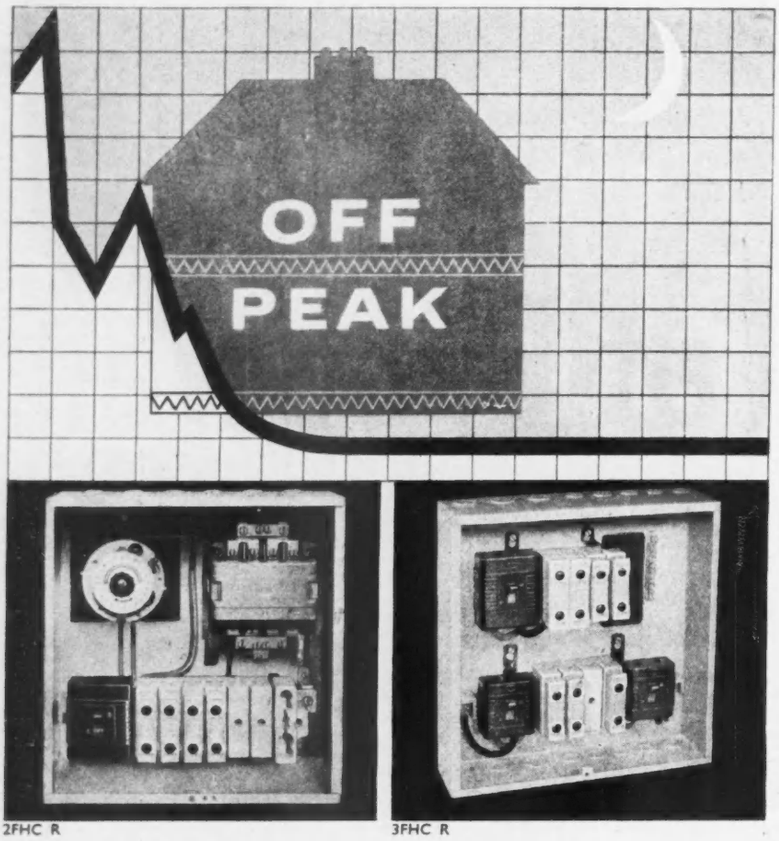

2FHC R

3FHC R

Under-floor heating and other off peak loads need these MEM Consumer's Control Units

Here is the MEM answer to the off peak load problem. The unit 2FHC/R on the left is designed for control of night load only, for those installations where the day load is already controlled and protected by separate control equipment. The unit comprises a mild sheet steel case 12" x 12" x 5", finished Ivory enamel. The front cover is sealable. The control unit contains a "MEM-AC" 60 amp. 250v. double pole main switch, and a time switch, which operates the 60 amp. single pole, 250 volt, 50 cycle "AUTOLINE" contactor.

The under-floor heating or storage heaters and water heater circuits are protected by 6-15 amp. "MEMCERT" S.P. & N. fuses.

The unit 3FHC/R illustrated left is designed to operate as a central control for the normal day load comprising lighting, power plugs, etc. In addition, within the same enclosure, main switches and circuit fuses are fitted for the control and protection of under-floor heating circuits, storage heaters, etc. Where desired, control units can be provided with time switch and "AUTOLINE" contactor for timed automatic control of the night load.

Prices can be quoted for Control Units to customers' own specifications.

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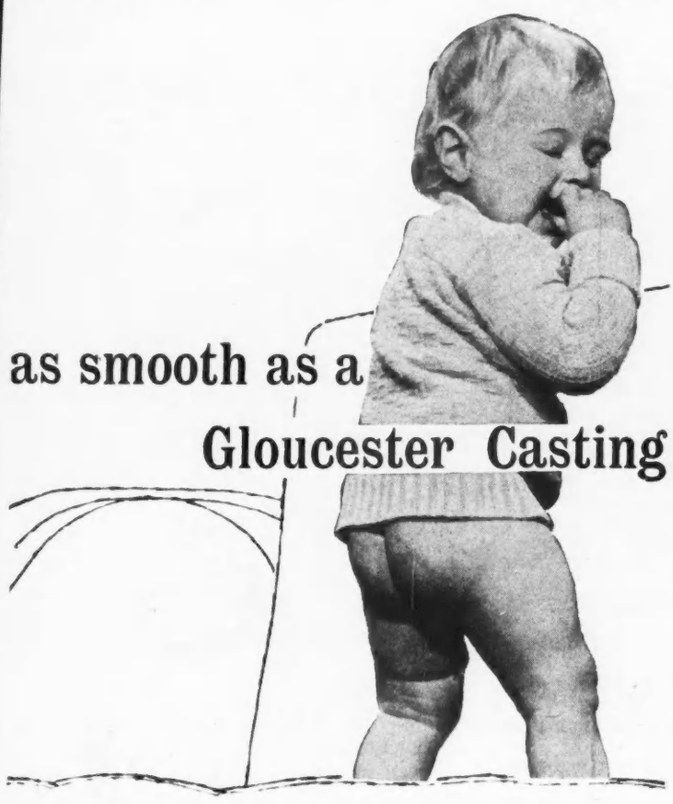

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The elevator type electric-furnace anneals in 48 hours instead of the usual 7 days. It also allows greater control of the casting during annealing, resulting in uniformity of metal, greater strength, and — a smoother, finer skin.

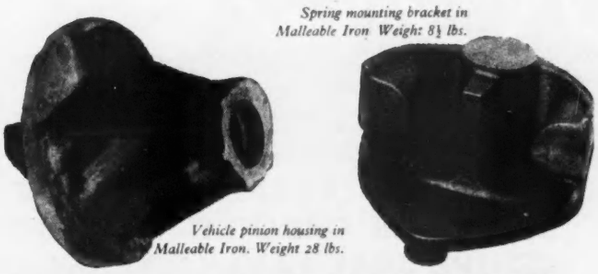
Gloucester can handle large runs of malleable and grey iron castings for the automobile, railway, electrical and farming industries.

Gloucester are always willing to visit customers and help in the design of castings to save time and cost in production.

A typical Gloucester Malleable specification.

Gloucester Blackheart Malleable	*Gloucester Lamellar Pearlitic Malleable*
Elongation .. 18%	Elongation .. 5%
Yield Point .. 12 tons	Yield Point .. 24 tons
Tensile Strength 25 tons psi	Tensile Strength 35 tons psi

Spring mounting bracket in Malleable Iron. Weight: 8¾ lbs.



Vehicle pinion housing in Malleable Iron. Weight 28 lbs.

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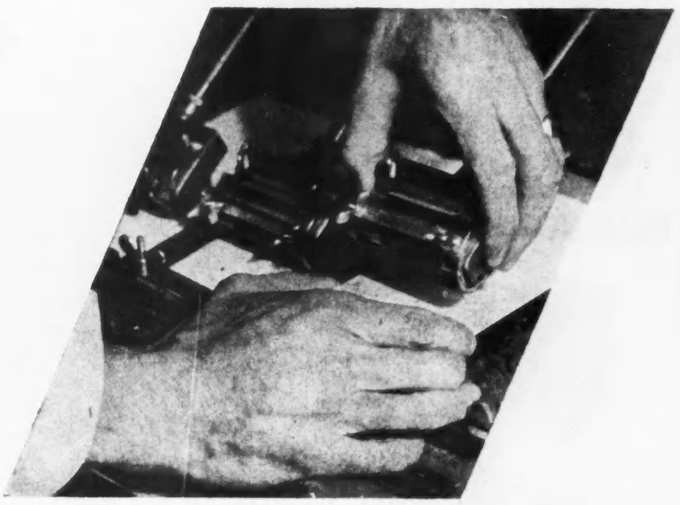

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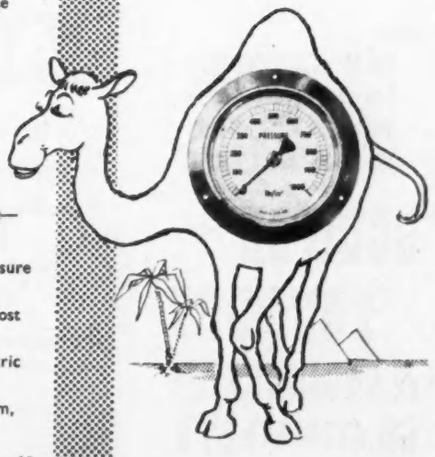
You can't gauge a camel...



. . . by its hump—or from the expression on its face for that matter.
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Write for publication No. 85

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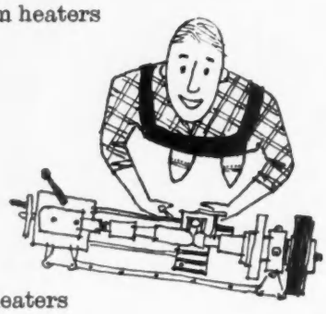

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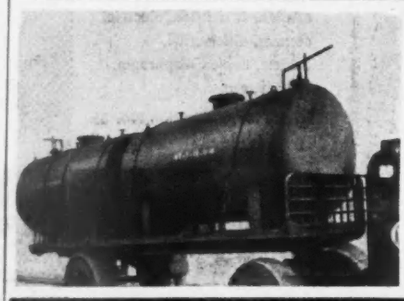

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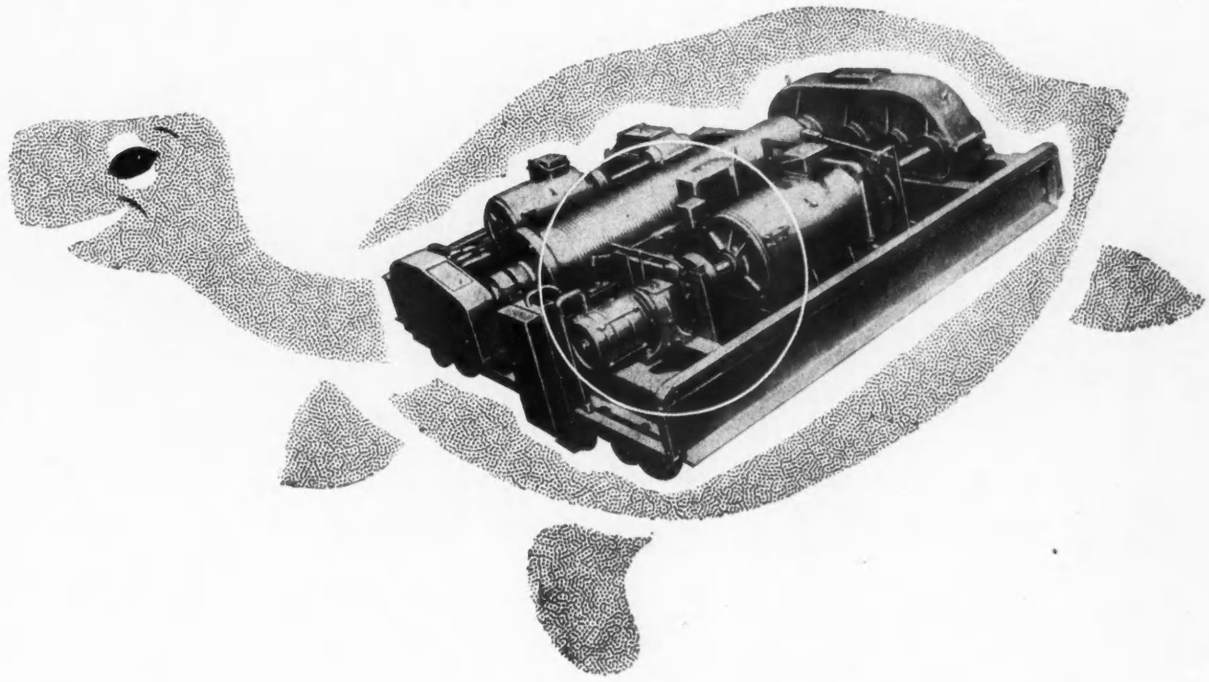

Slomax Creep-Speed Control

This system was developed to meet the need for a controlled creeping speed for all motions of cranes on A.C. supply where precise slow-speeds are required.

The success of this well-tried system, proved under arduous conditions, lies in its extreme simplicity.

The device is entirely automatic and fool-proof.

The main motor is not energised when the creeping speed is in operation.

The operating circuits being electrically inter-locked, it is impossible for the main motor and the Slomax motor to operate simultaneously.

Slomax control permits an unlimited ratio between creeping and normal speeds, and whilst ten to one is usual, a ratio of fifty to one is not uncommon for specialised duties.

A further advantage is that where precise creeping speeds are required for specialised operations, the Slomax control will ensure a predetermined creeping speed, irrespective of the load on the hook.

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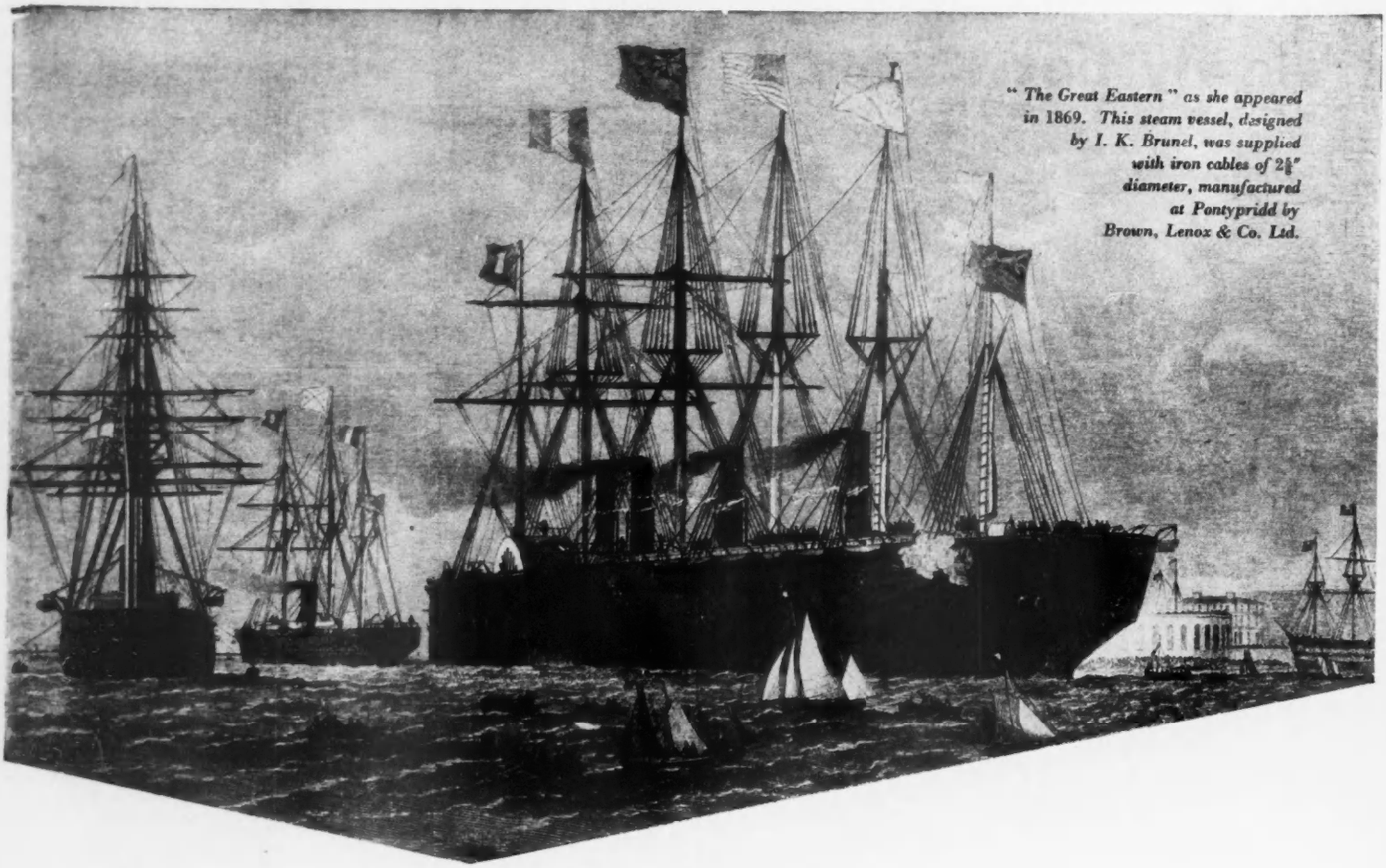
CANADA: Marshall Equipment Co. Inc., P.O. Box 28, 61 Victoria Avenue, Dorval Station, P.Q.	Phone: Melrose 1-3528.	Grams: Marquipco, Montreal.



" The Great Eastern " as she appeared in 1869. This steam vessel, designed by I. K. Brunel, was supplied with iron cables of 2⅝" diameter, manufactured at Pontypridd by Brown, Lenox & Co. Ltd.

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From 1808 until 1916 the Company unbrokenly, year by year, was awarded the contract for the British Admiralty chain cable requirements.

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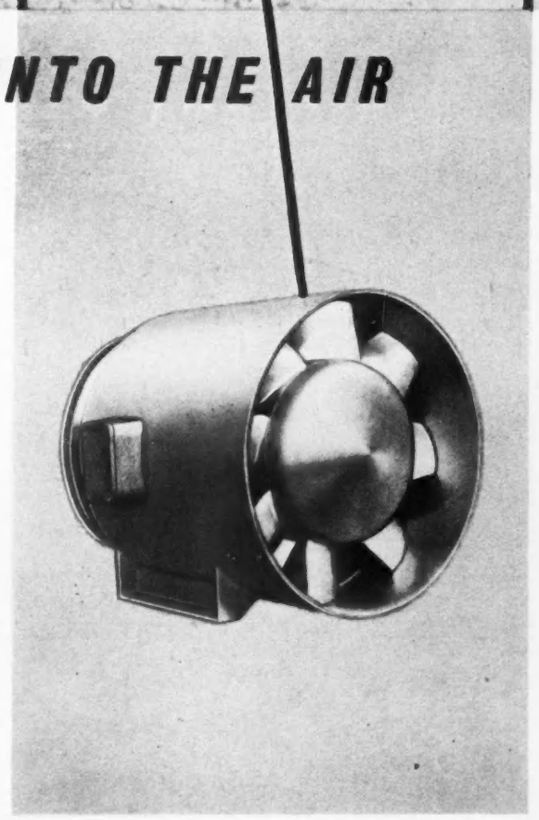

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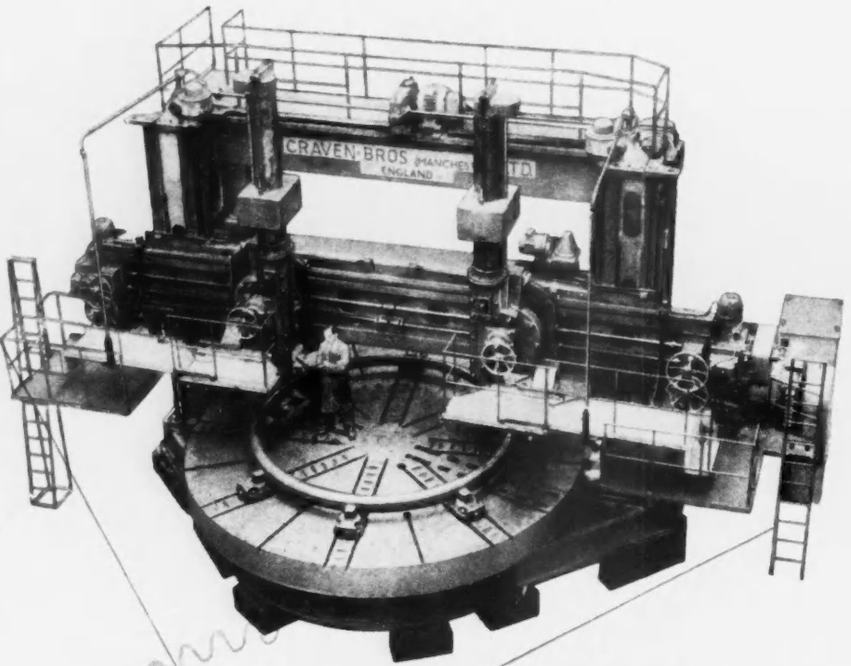

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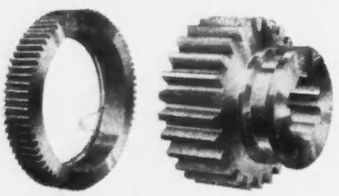

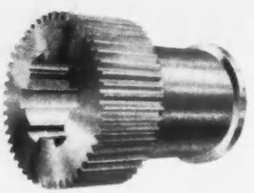

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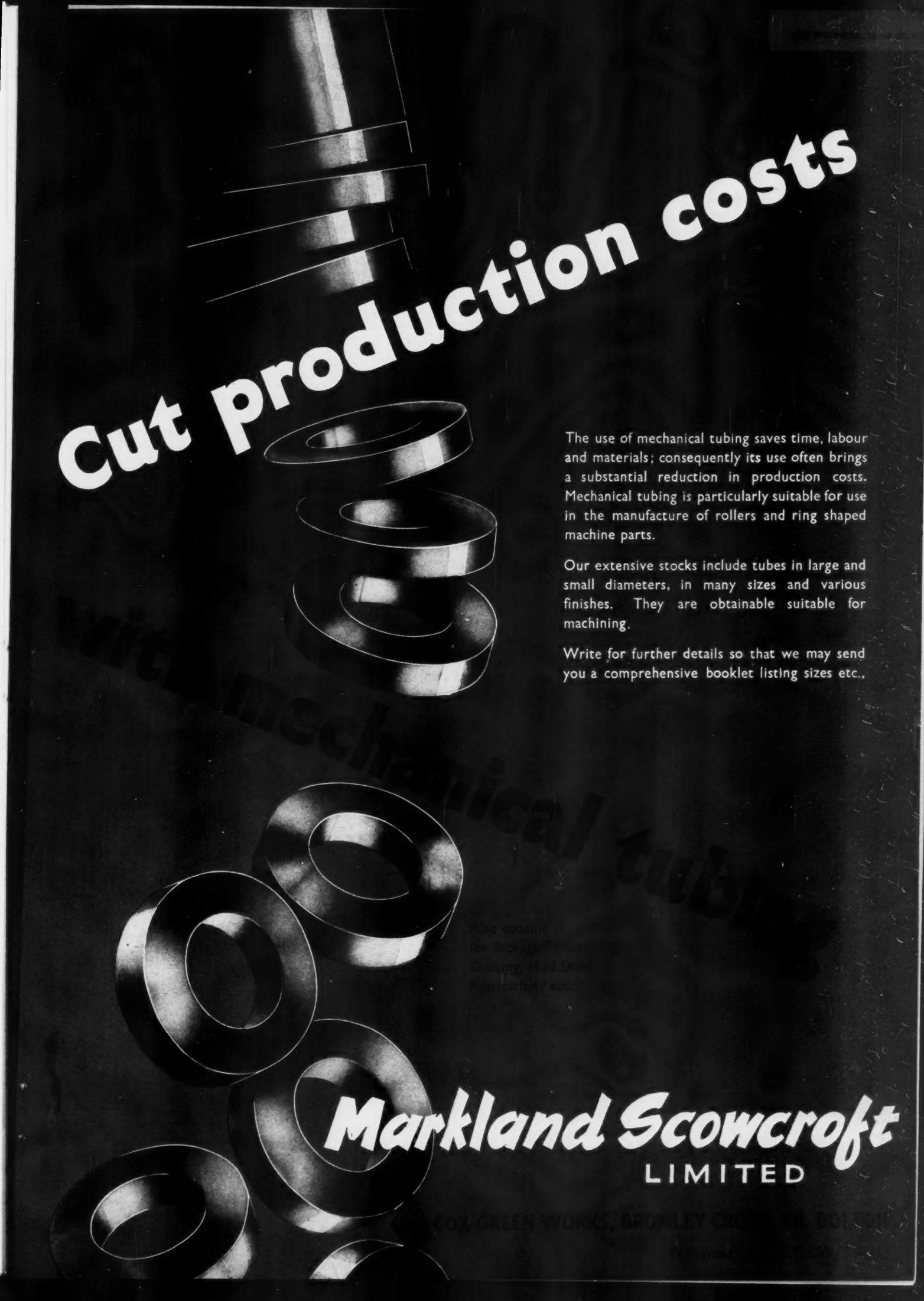

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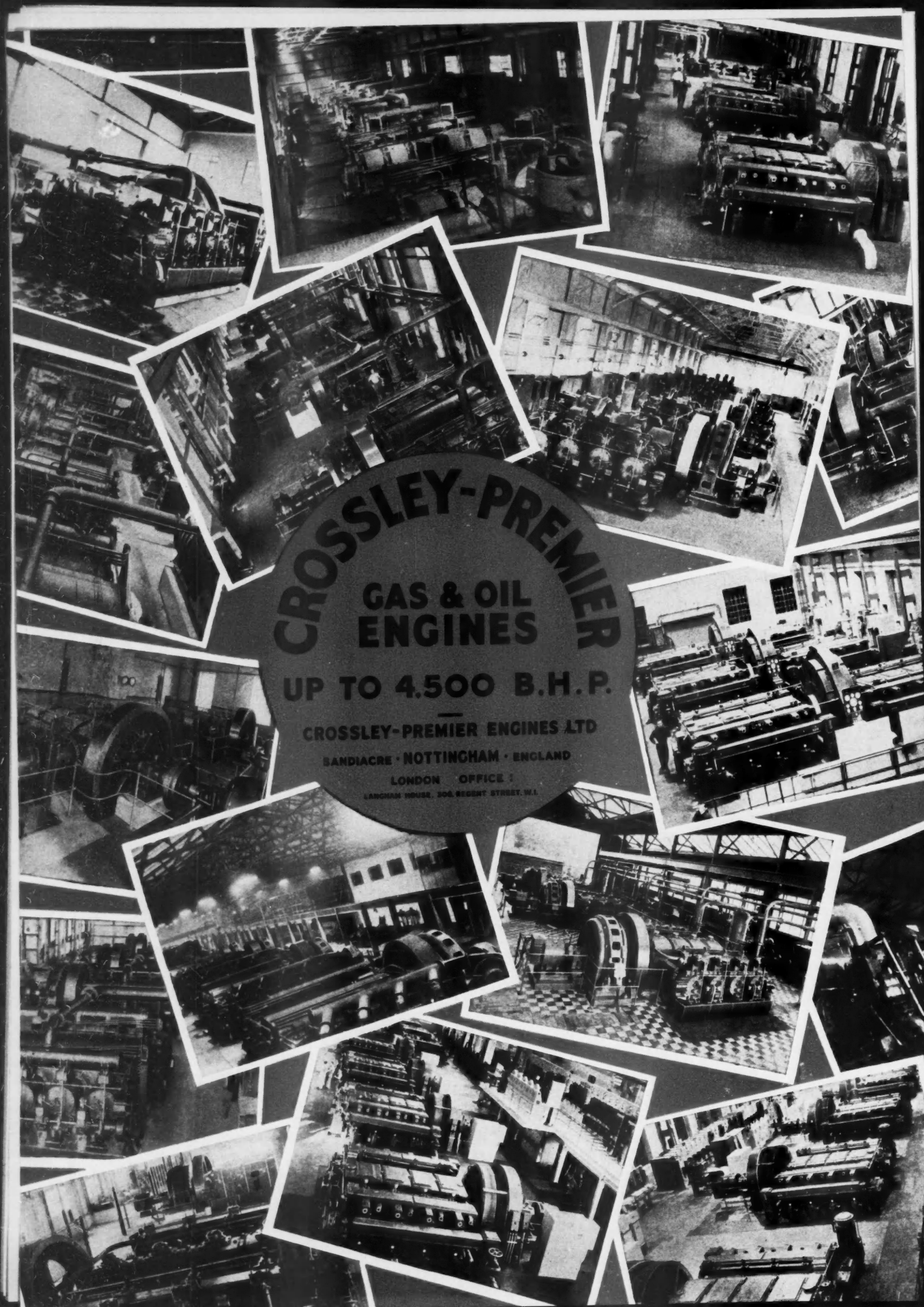
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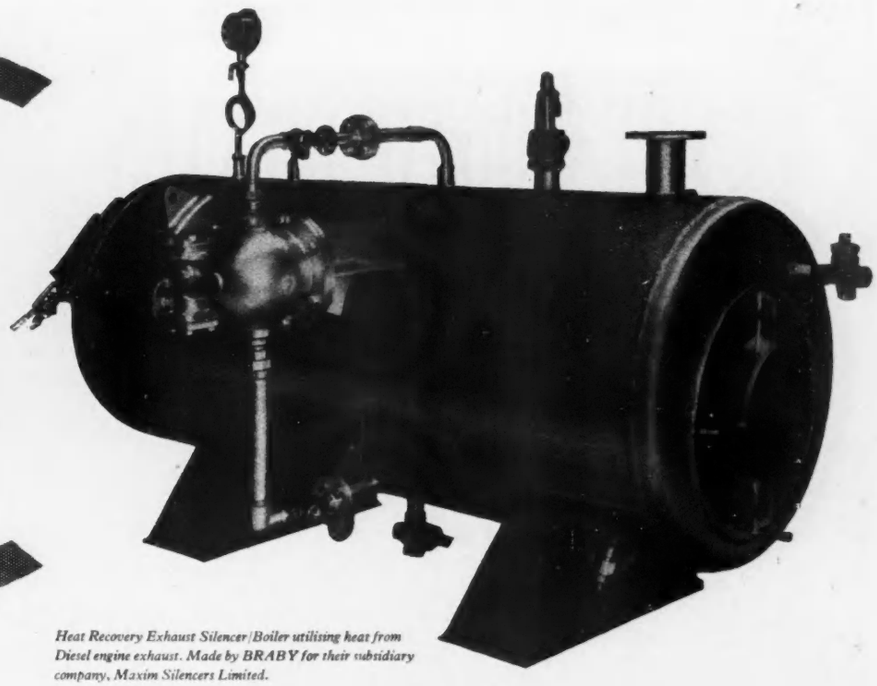

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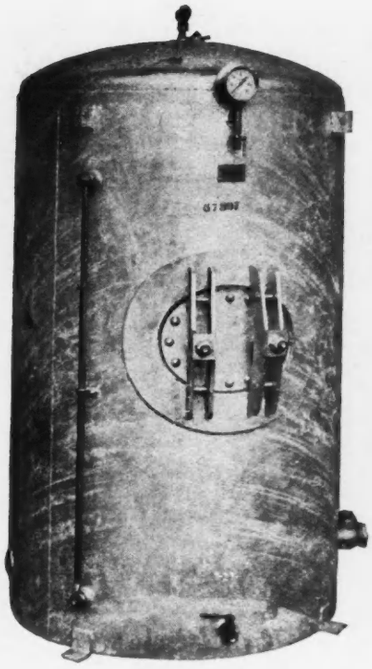
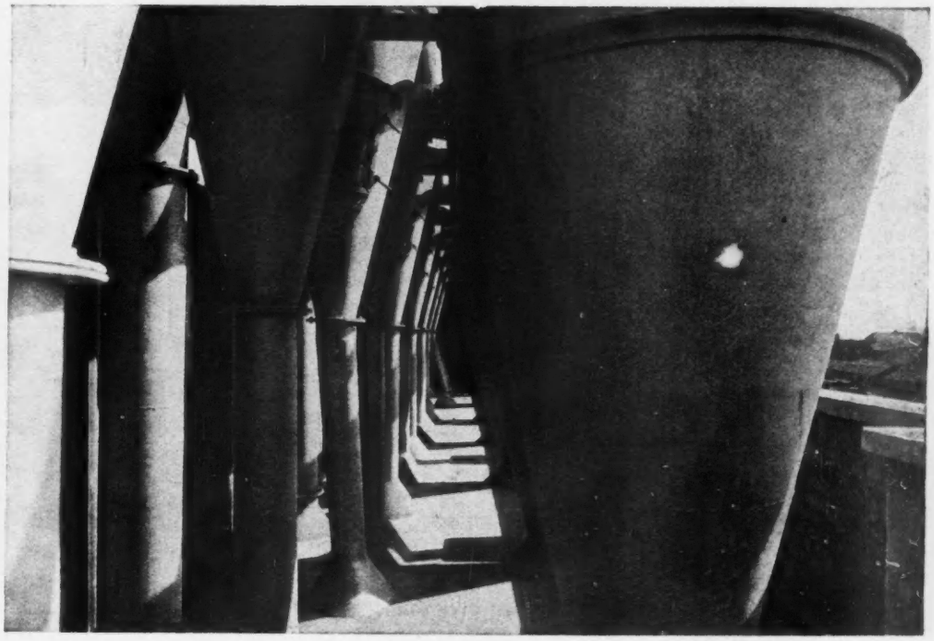


Pressure Cylinder supplied to Mono Pumps Limited.



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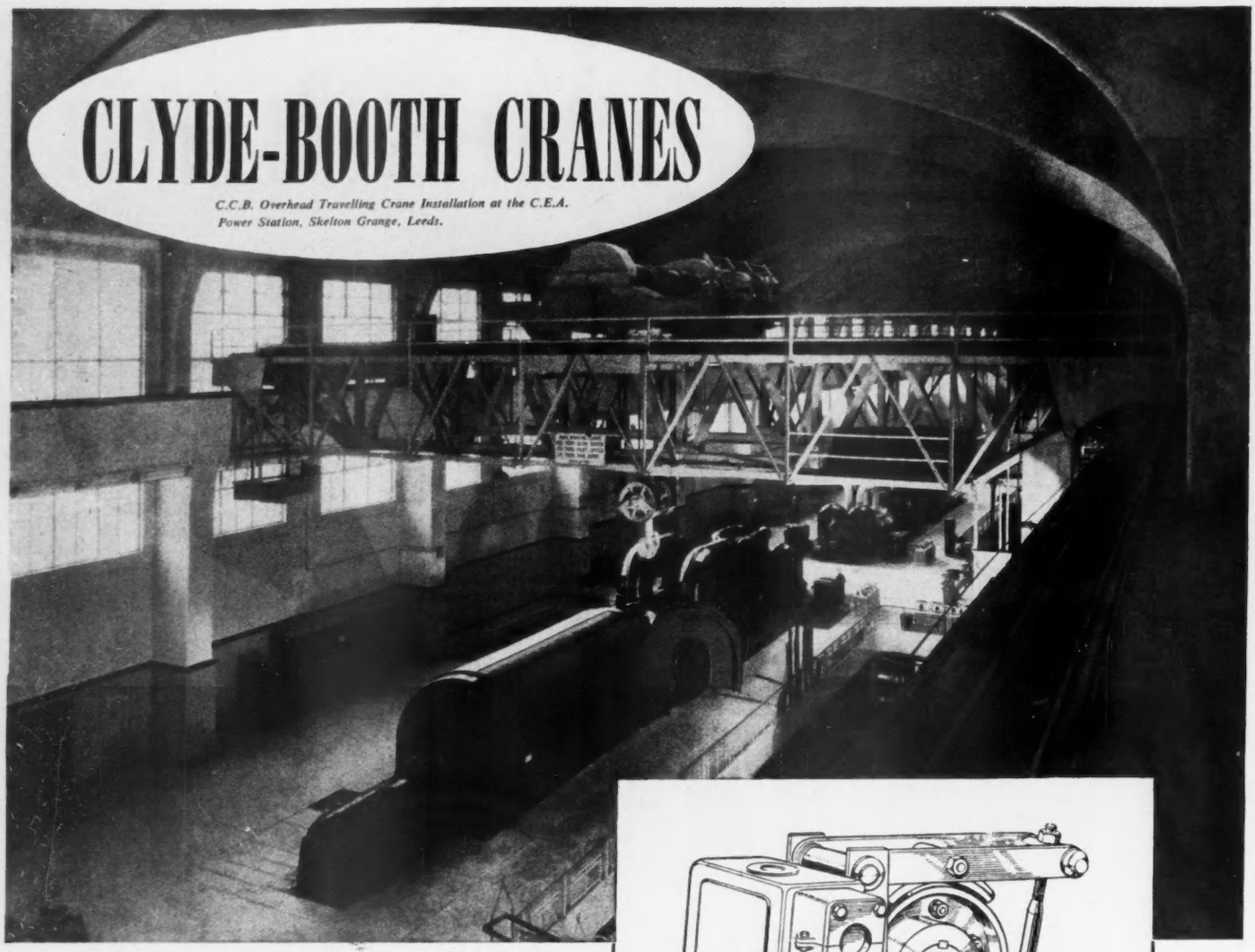

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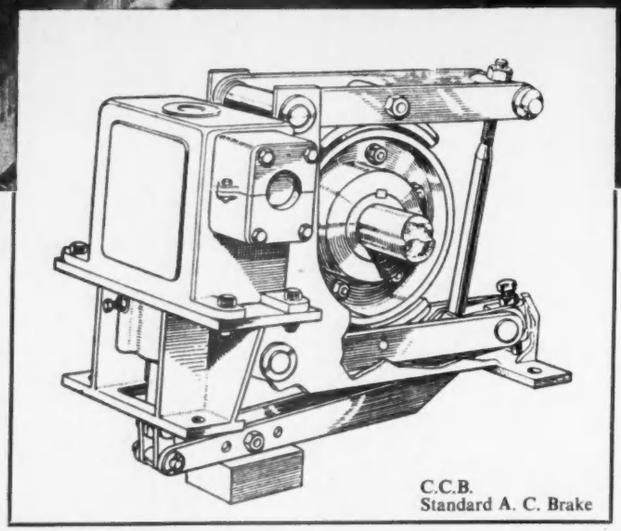

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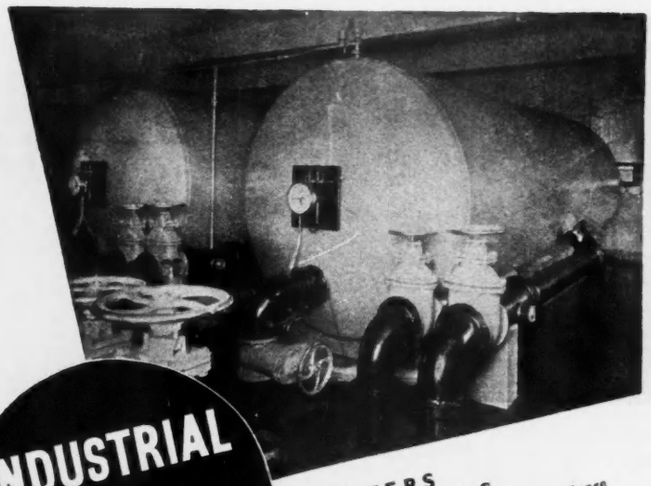

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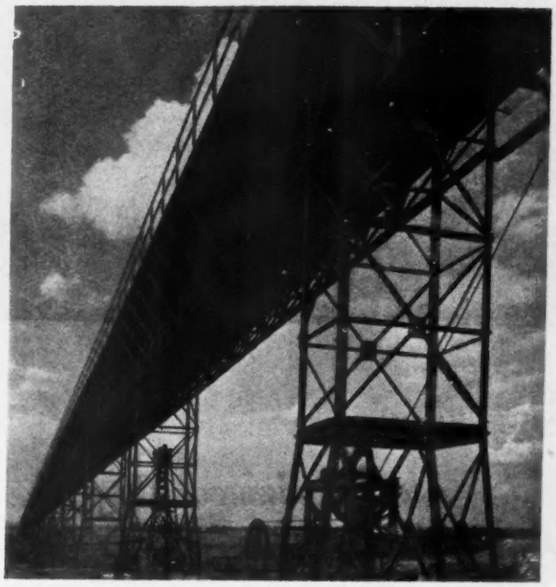

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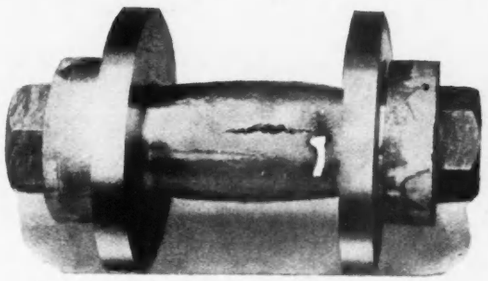
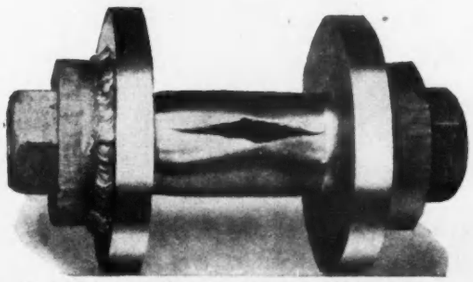


Gun-metal **0·25 in.** *thick—burst at* 4480. *lbs. per sq. in.*



Aluminium-bronze **0·10 in.** *thick—burst at* 4816 *lbs. per sq. in.*

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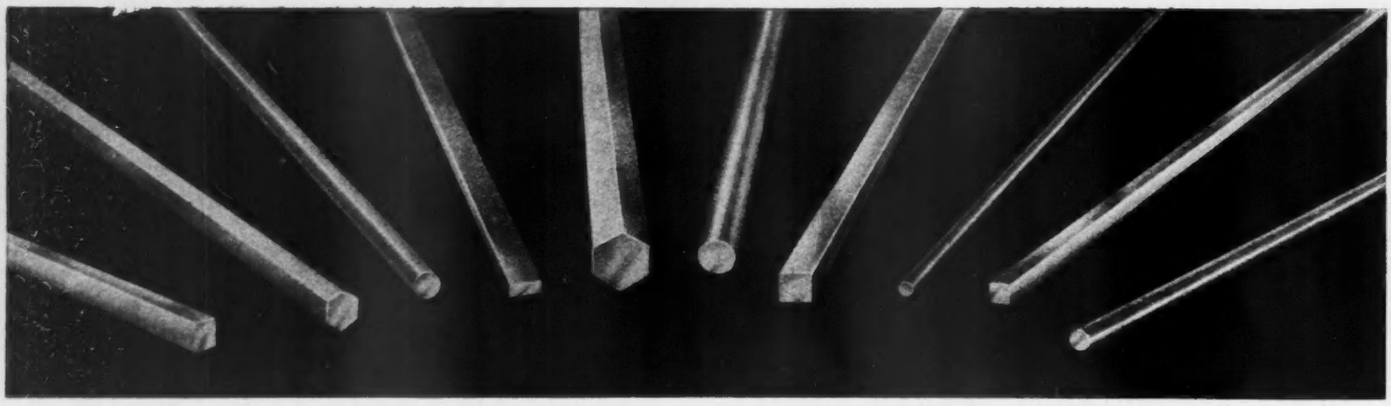
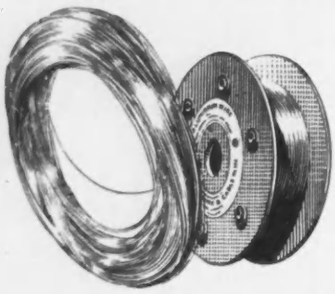


Aluminium

and Aluminium Alloy wire



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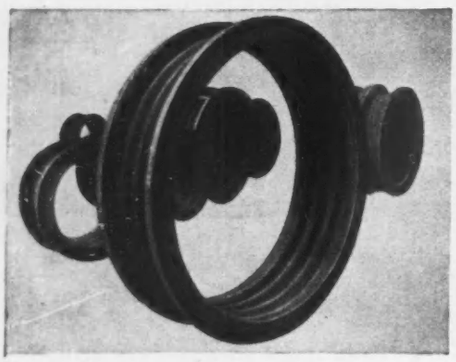

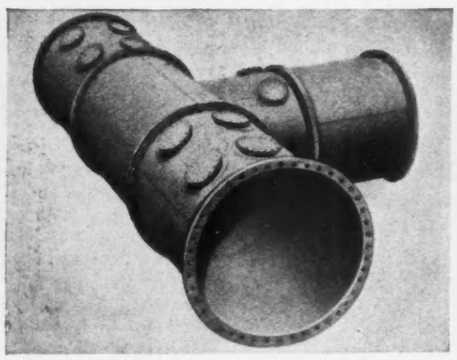

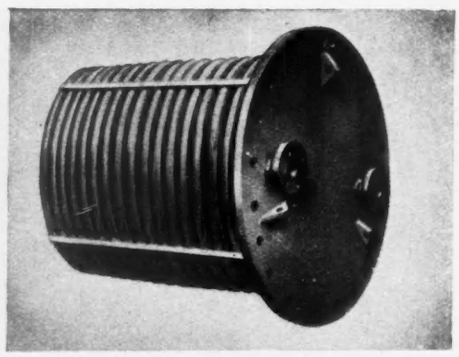

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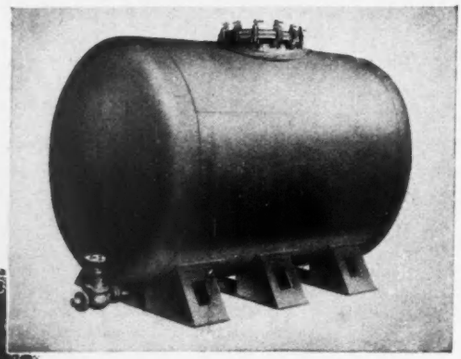

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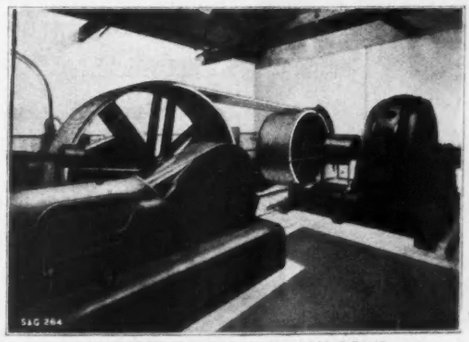

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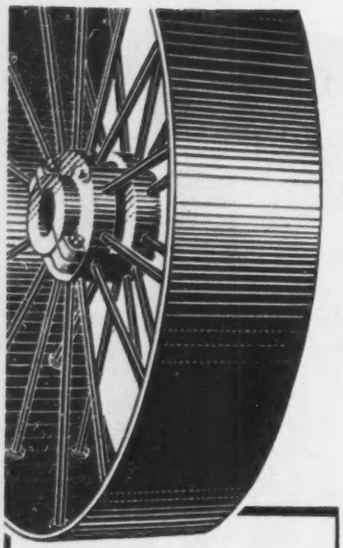

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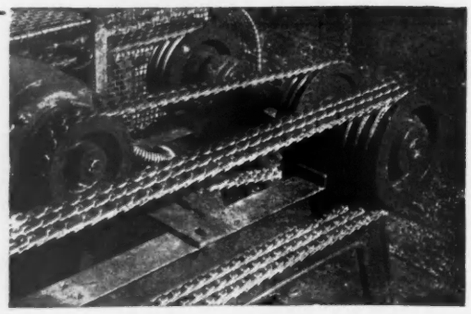

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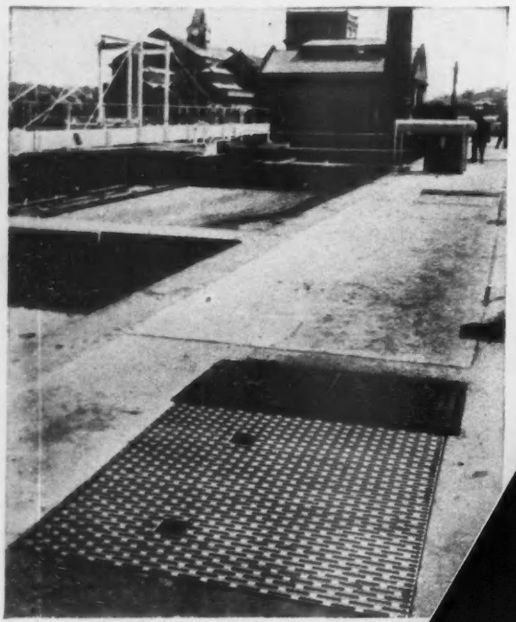

Alaflor grid flooring as installed over the de-sludging valve chambers of the sedimentation tanks at Derby Corporation reconstructed sewage disposal works. Consulting Engineers: Messrs. J. D. & D. M. Watson. Photograph reproduced by courtesy of Mr M. L. Francis, F.R.I.C.S., M.I.Mun.E., Borough Engineer and Surveyor

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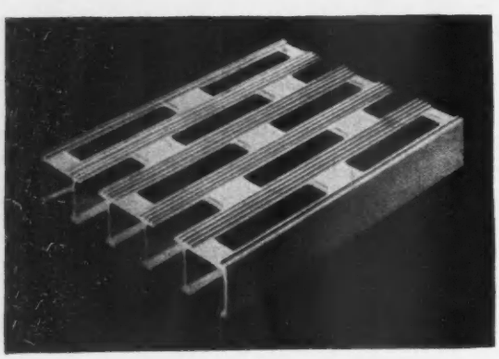

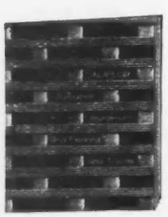

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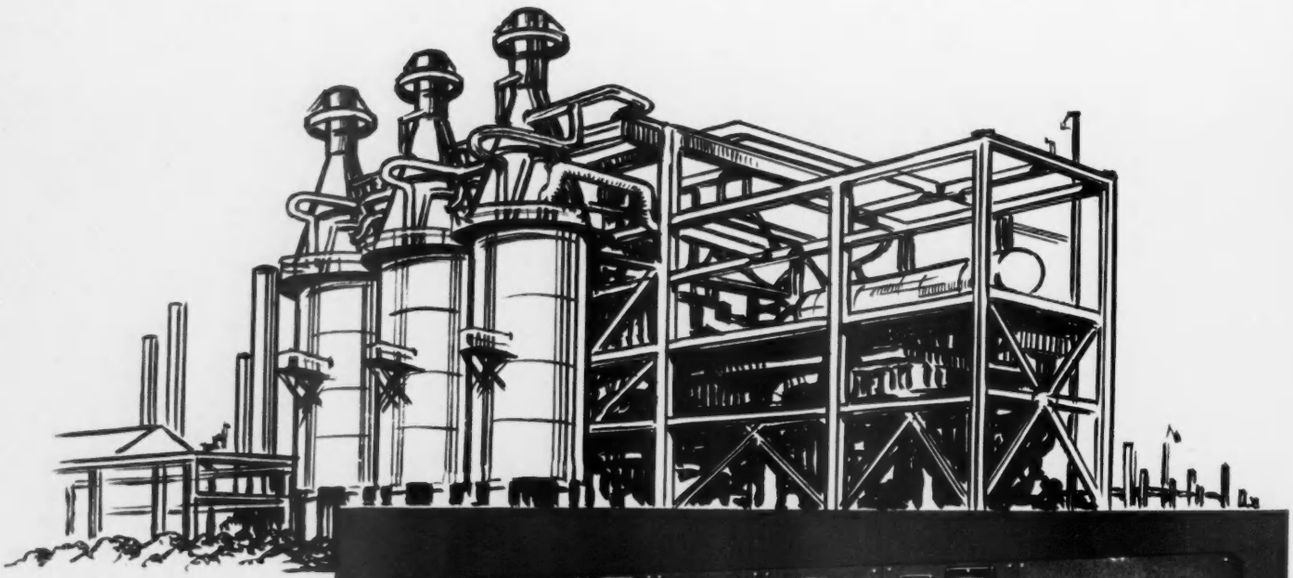

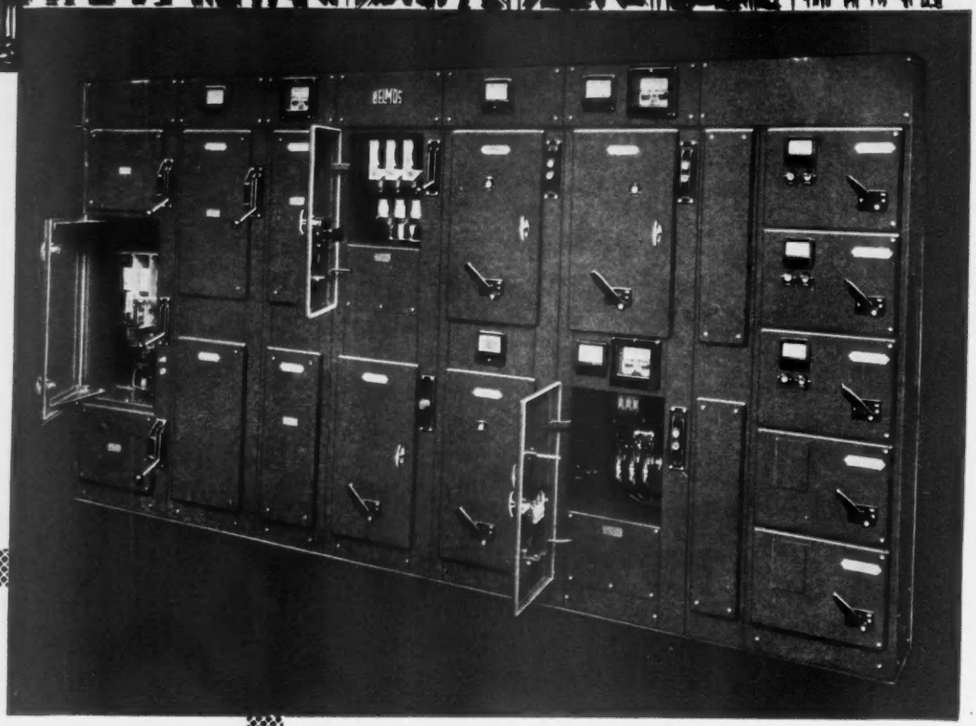

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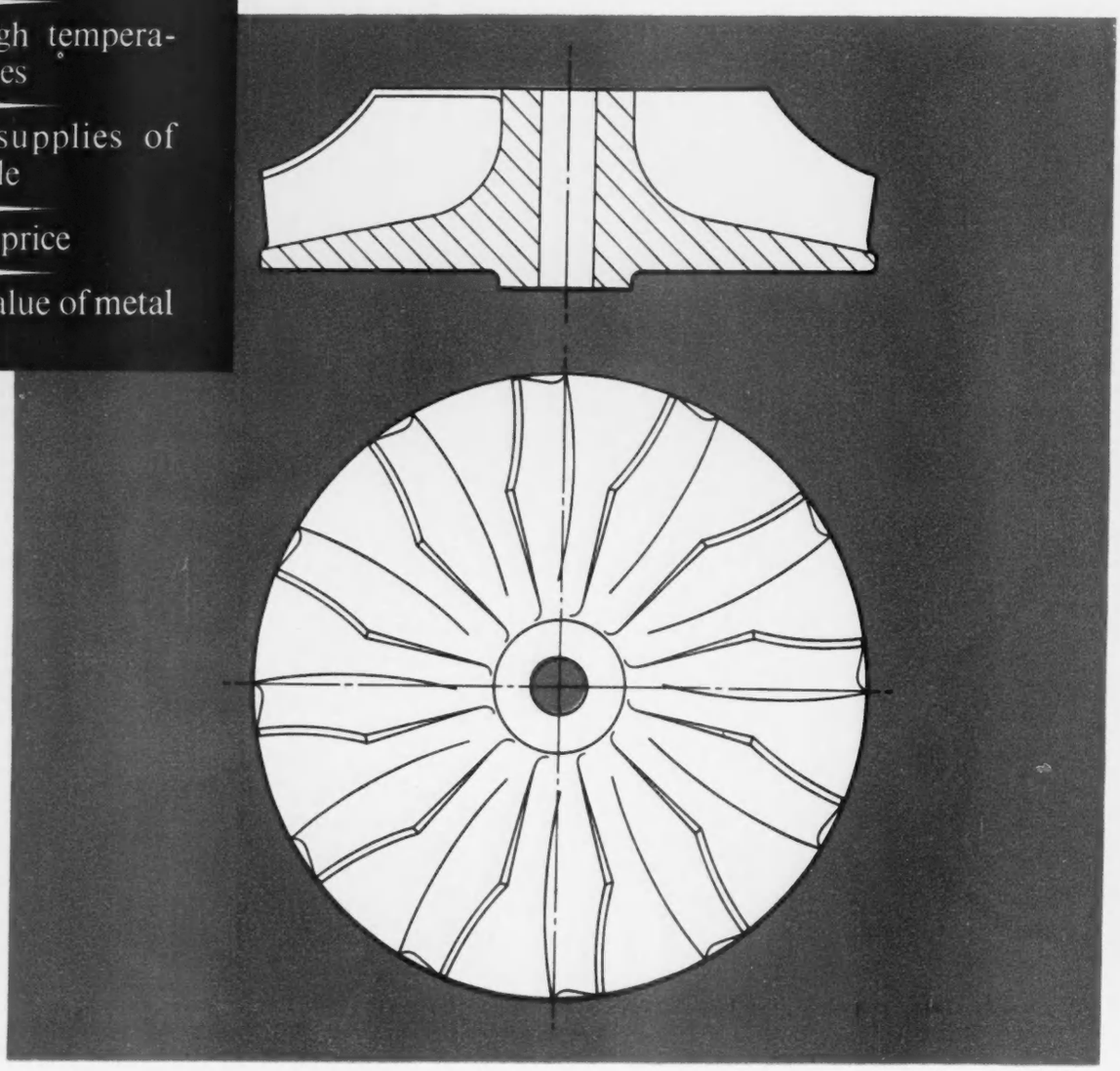

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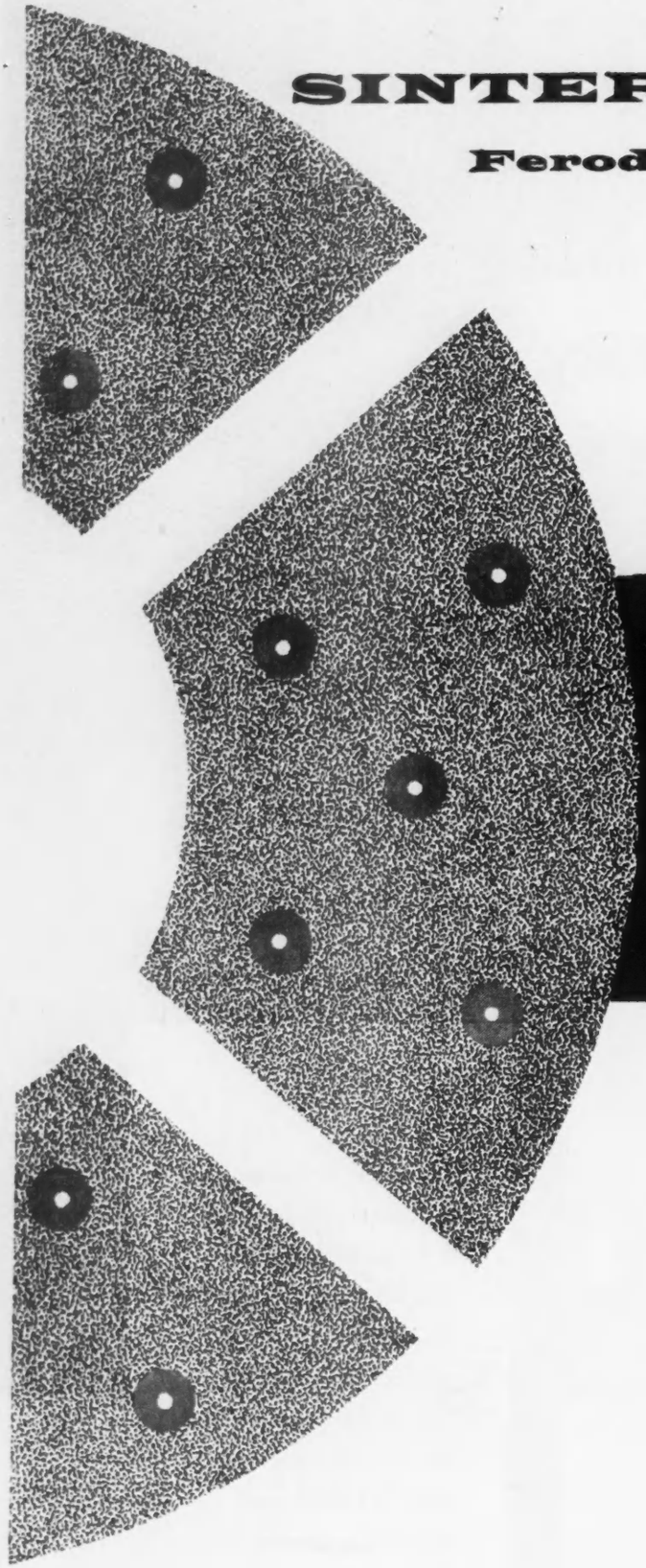

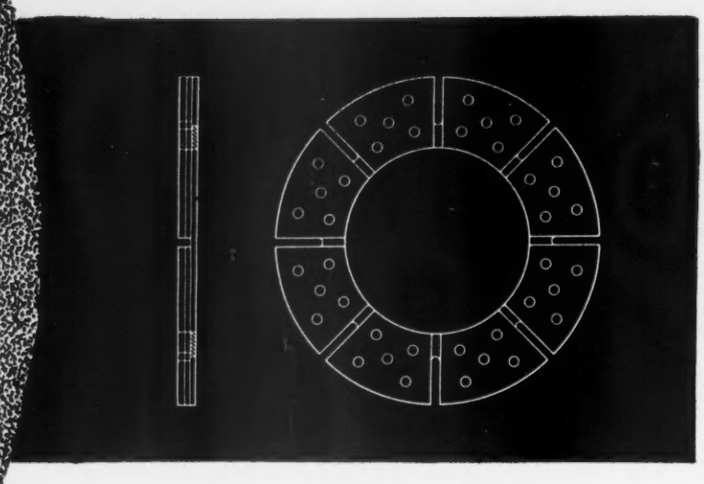

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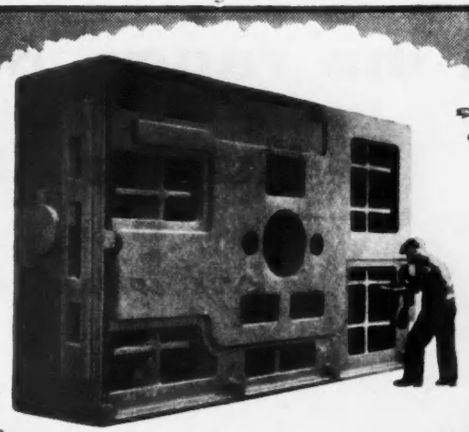

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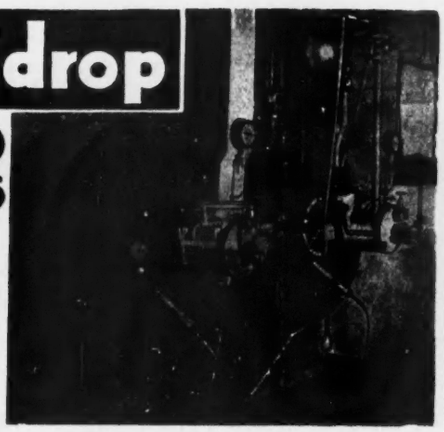

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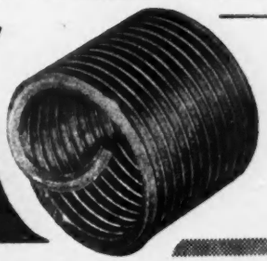

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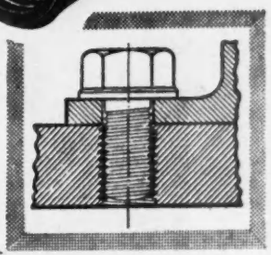

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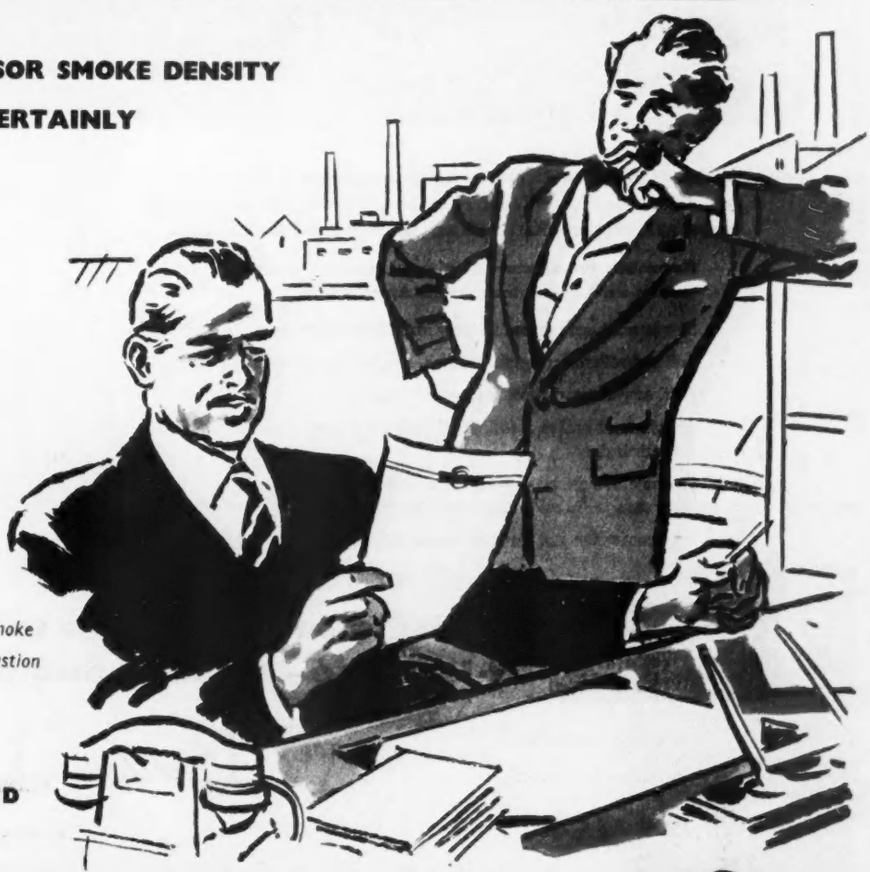

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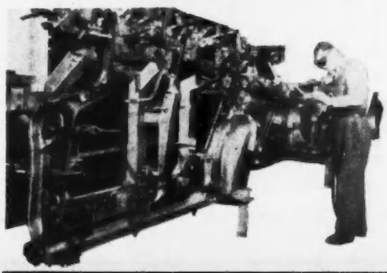

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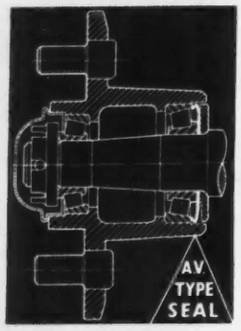

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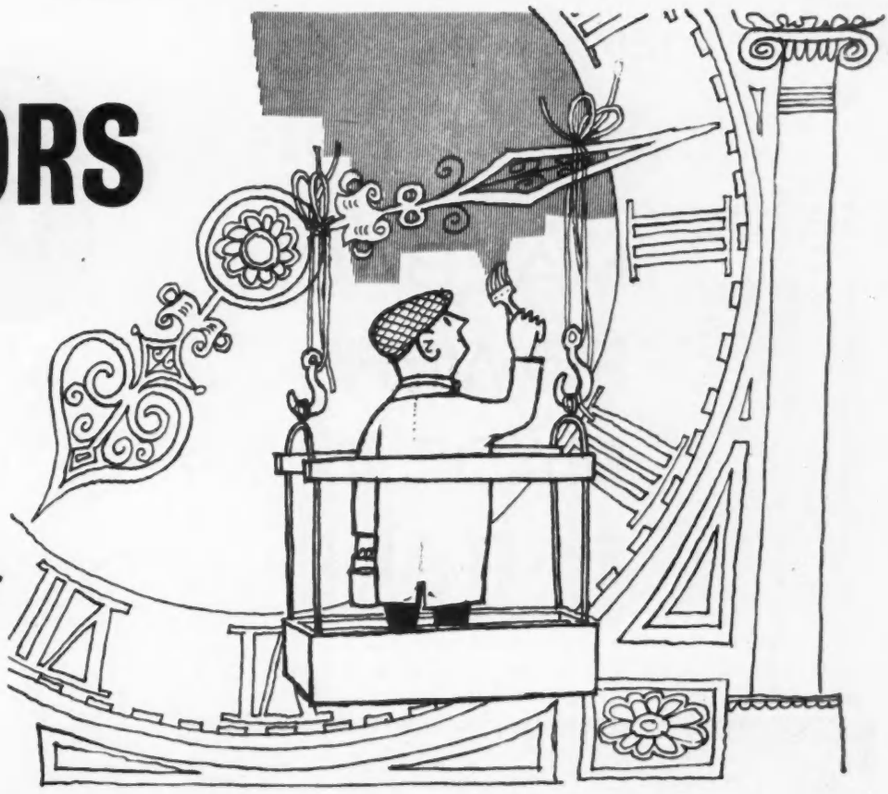

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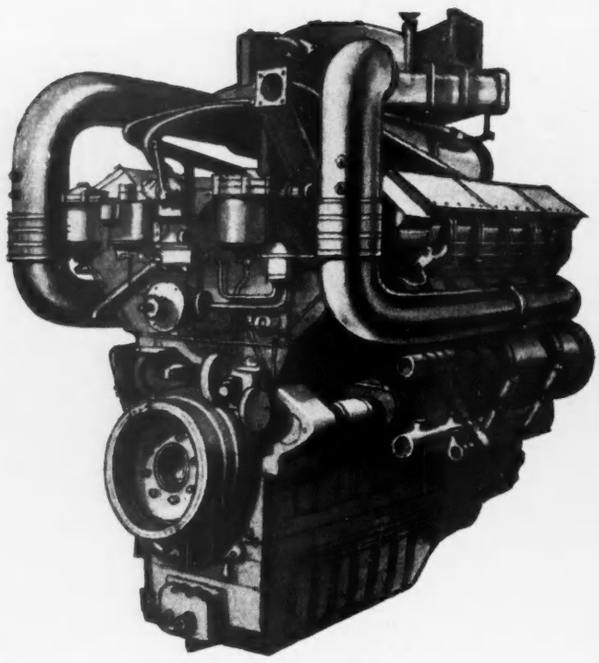

Typical of the MD range of engines is this Type 650 12 cylinder supercharged model with cylinders arranged in 'V' formation.

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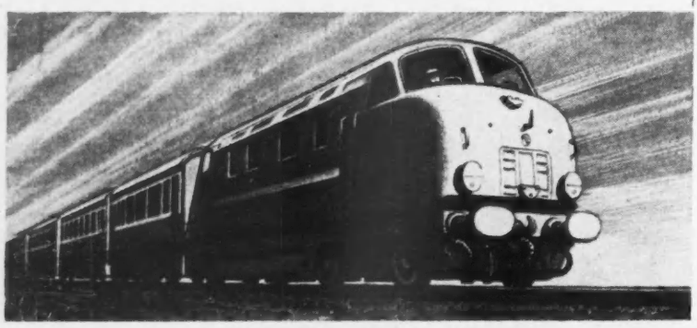

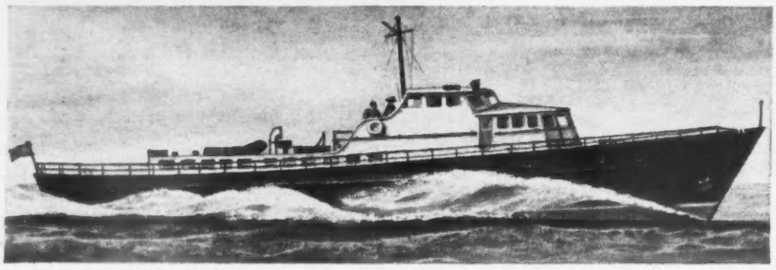

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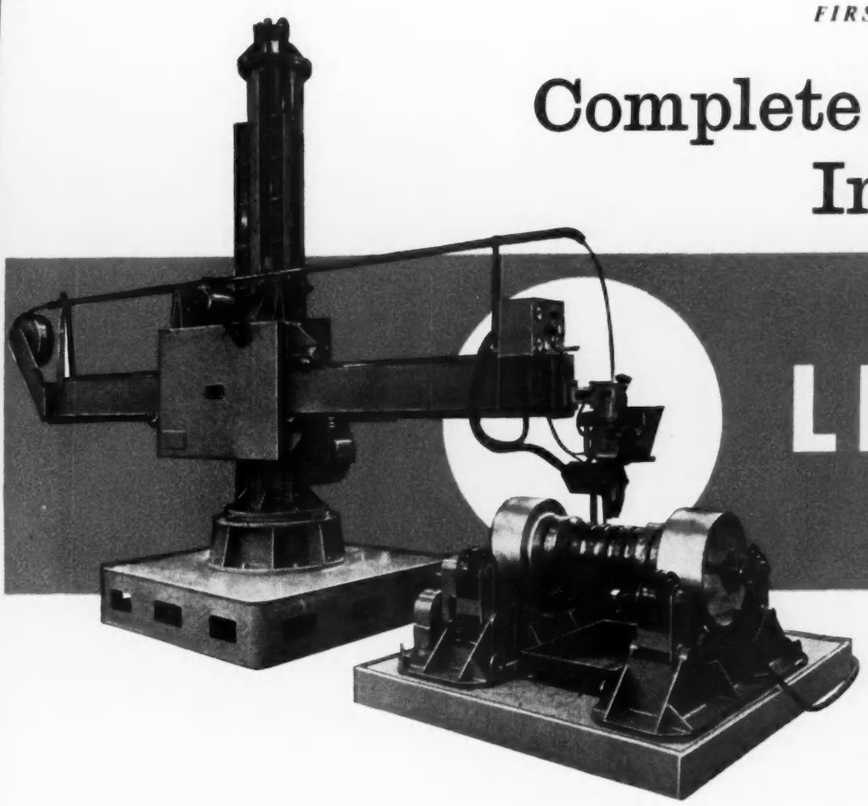

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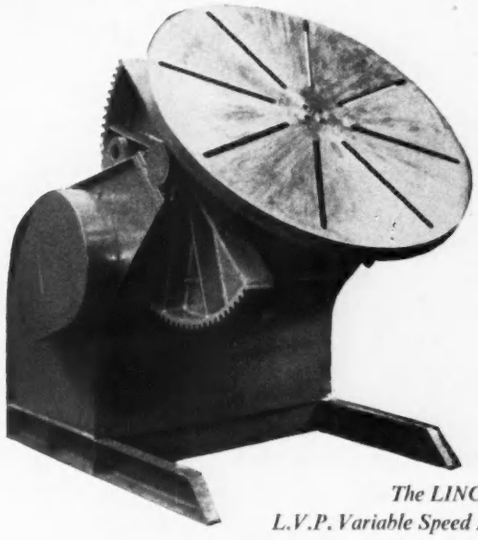

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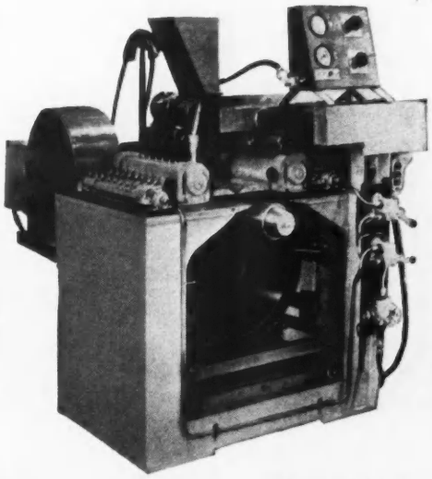
To see how the LINCOLN Complete Welding Installation Service can help to solve your production problem, please write to:



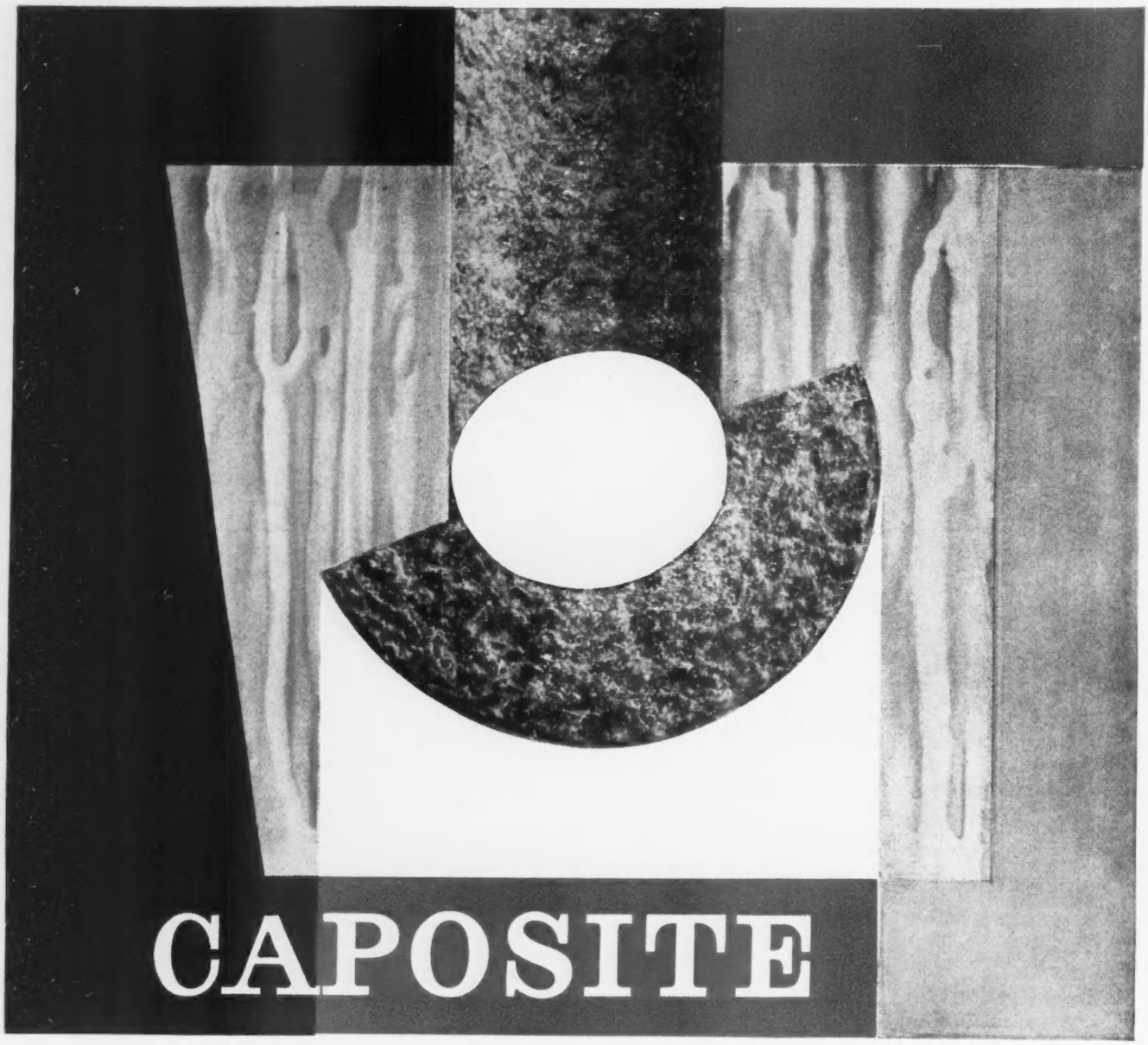
A LINCOLN Seam Welding Machine, incorporating the LINCOLNWELD M.L.3. Remote Control Automatic Submerged Arc Welding Unit.

The Automatic Division

LINCOLN ELECTRIC COMPANY LIMITED

WELWYN GARDEN CITY · HERTS · TEL: 920/4 4581/5

PS



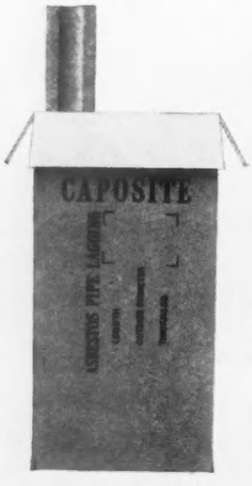
CAPOSITE

INSULATION

'efficient, economical'

Caposite insulation has high thermal efficiency due to its being made from unique long fibred amosite asbestos from the company's own mines. These long fibres give Caposite great mechanical strength, enable it to be preformed in large sizes, and to be applied as a single layer.

amosite asbestos preformed insulation



CAPOSITE is clean

clean to cut and sweep away—no mess to stick to boots. It comes in light, non-returnable cartons which make handy off-cut bins—there's no waste with Caposite.

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THE CAPE ASBESTOS CO LTD
114 & 116 PARK STREET, LONDON W.1. GROsvenor 6022

GLASGOW: Hobden Street, Petershill Road, Glasgow N.1. Springburn 6144
MANCHESTER: Floor D, National Buildings, St. Mary's Parsonage, Manchester 3. Deansgate 6016-7-8
BIRMINGHAM: 11 Waterloo Street, Birmingham 2. Midland 6565-6-7
NEWCASTLE: 19 & 20 Exchange Buildings, Newcastle. Newcastle 20488

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Metrovick Electrode

FOR EVERY WELDING JOB

For all-position welding of mild steel the

VERTIVICK

- For structural work, particularly shipbuilding and constructional engineering.
- Outstanding for vertical and overhead work, and work in grooves difficult of access.
- Easy-to-strike, stable arc. Smooth transfer and negligible spatter.
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- Gives finely finished welds free of undercut, and flat downhand fillets.
- Approvals include Lloyds, Ministry of Transport and the Admiralty.

For full technical details write for descriptive leaflet 787/7-1

The Metrovick range of 'Giant Builder' Electrodes includes

EH · SYLVICK · MINIVICK · UNIVICK
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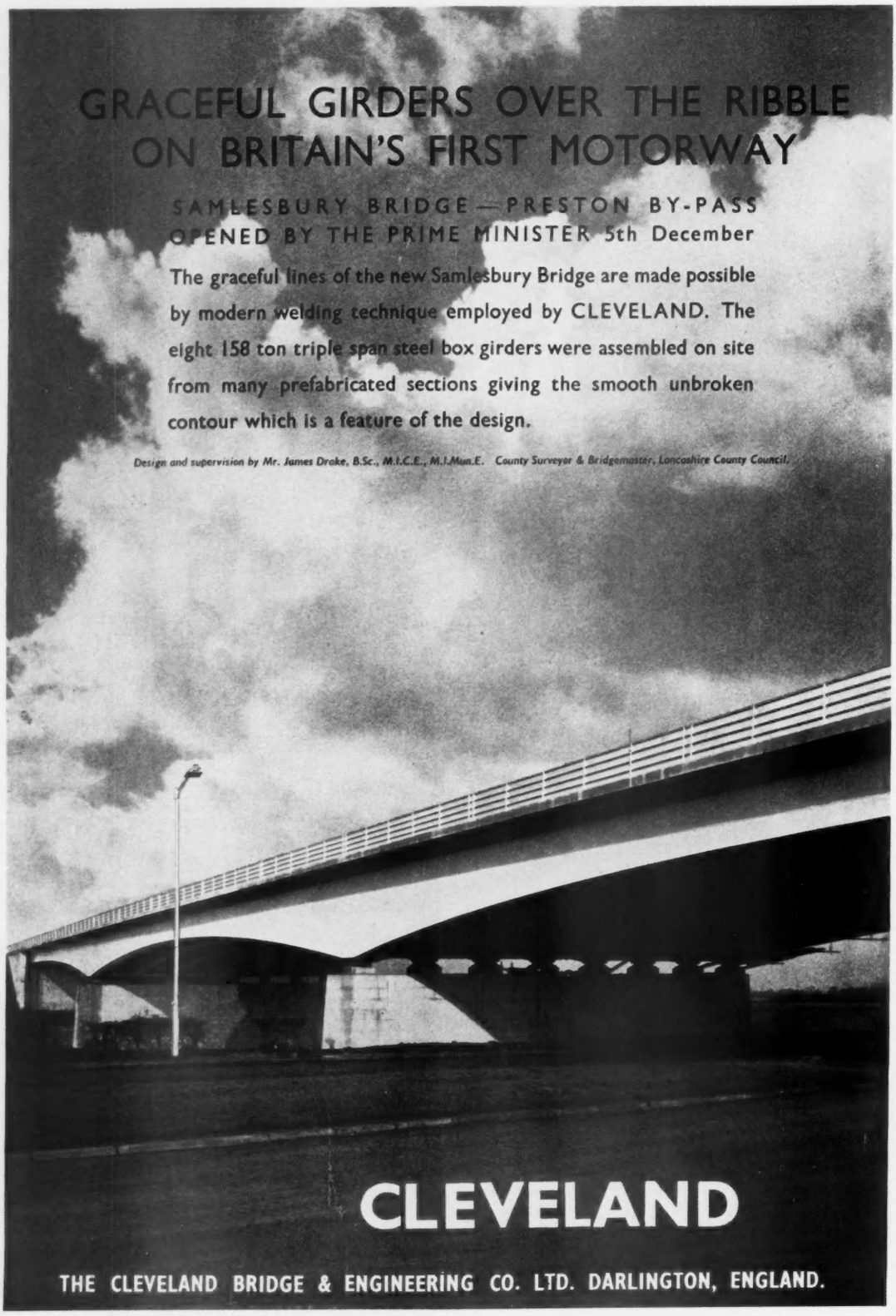
P250 · MOLVICK · LOCREEP

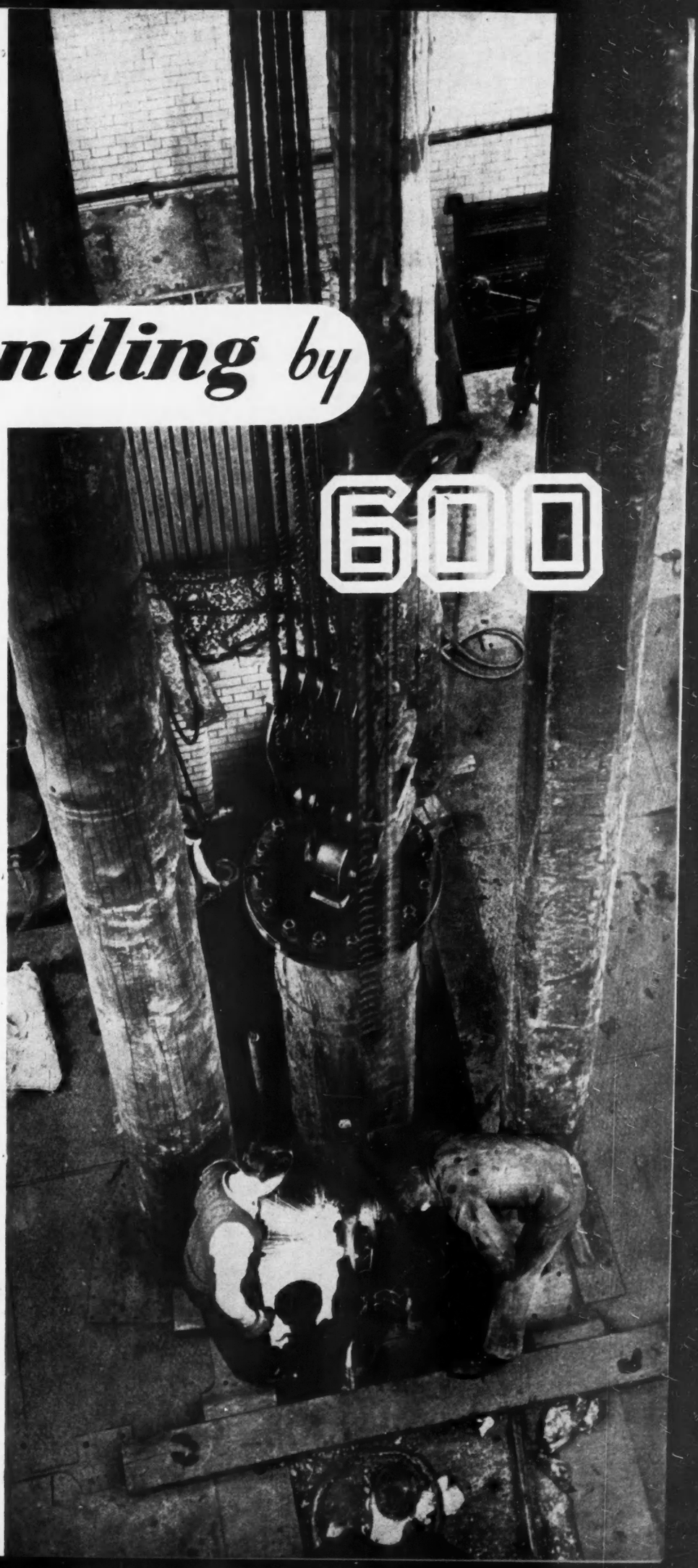
METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

An A.E.I. Company

L/P806


GRACEFUL GIRDERS OVER THE RIBBLE
ON BRITAIN'S FIRST MOTORWAY
SAMLESBURY BRIDGE — PRESTON BY-PASS
OPENED BY THE PRIME MINISTER 5th December
The graceful lines of the new Samlesbury Bridge are made possible by modern welding technique employed by CLEVELAND. The eight 158 ton triple span steel box girders were assembled on site from many prefabricated sections giving the smooth unbroken contour which is a feature of the design.
Design and supervision by Mr. James Drake, B.Sc., M.I.C.E., M.I.Mun.E. County Surveyor & Bridgemaster, Lancashire County Council.
CLEVELAND
THE CLEVELAND BRIDGE & ENGINEERING CO. LTD. DARLINGTON, ENGLAND.

Dismantling by 600



An Intercontinental
Ballistic Missile? No,
a quite humble, quite
unspectacular rising main.
This one is rising for
the last time and straight-
forward though the job may
look, it needed careful
planning and not
a little ingenuity.
Anticipation, organisation
and the
unmatched experience of
George Cohen's.

THE 600 GROUP OF COMPANIES

GEORGE COHEN

SONS AND COMPANY LIMITED

RAW MATERIALS DIVISION

Established 1834

WOOD LANE, LONDON, W.12 · *Telephone:* Shepherd's Bush 2070 · *Telegrams:* Coborn, Telex, London · And at 600 Commercial Road, E.14 · Canning Town. E.16 · Southall, Middlesex · Bath · Belfast · Kingsbury · Manchester · Hebburn Leeds · Luton · Sheffield · Swansea · Southampton · Glasgow

CENTRAL ELECTRICITY GENERATING BOARD

TARIFF FOR BULK SUPPLIES TO AREA BOARDS

fixed by the Central Electricity Generating Board (the Generating Board) pursuant to section 37 (1) of the Electricity Act, 1947, for the year ending 31st March, 1960.

KILOWATT CHARGE

£7.2s.0d. (seven pounds two shillings) for each kilowatt of simultaneous maximum demand where "simultaneous maximum demand" means either

(a) twice the largest number of kilowatt-hours supplied by the Generating Board to the Area Board during any half-hour between 7 a.m. and 7 p.m. on any Monday, Tuesday, Wednesday, Thursday or Friday or between 7 a.m. and 12 noon on any Saturday in the year

or, if the sum of the simultaneous maximum demands (ascertained according to paragraph (a) above) of each Area Board and the chargeable maximum demands in the year of the other direct consumers of the Generating Board differs from 22,340,000 kilowatts

(b) the simultaneous maximum demand ascertained according to paragraph (a) above multiplied by 22,340,000 and divided by the number of kilowatts in the said sum mentioned above.

RUNNING CHARGE

0.41d. (decimal four one of a penny) for each kilowatt-hour supplied during the year, this charge to be increased or reduced by 0.00055d. (decimal nought nought nought five five of a penny) for each penny (a halfpenny or any greater part of a penny being treated as a penny) by which the fuel cost per ton in the year shall be above or below 60s. (sixty shillings).

For this purpose—

(i) **"Fuel cost per ton"** in any period shall be either

(a) the quotient produced by dividing—The aggregate of the product of the **Area fuel cost per ton** in the period and the **number of kilowatt-hours supplied from generation in the Area** in the period and the product of **the residual cost per ton** in the period and **the number of kilowatt-hours imported into the Area** if any in the period

by **the number of kilowatt-hours supplied in the Area** in the period;

or (b) **the Area fuel cost per ton ;**
whichever is the less.

(ii) **"The Area"** means the Area of the Area Board taking the supply.

(iii) **"The Area fuel cost per ton"** in any period shall be determined as follows: the total **cost of fuel consumed** in the period at all the Generating Board's stations in **the Area** shall be divided by the total number of tons of **fuel** so consumed and the cost per ton so obtained shall be multiplied by 11,000 and divided by the average gross thermal value of **fuel** so consumed expressed in British thermal units per pound.

(iv) **"Fuel"** shall mean coal, coke and oil fuels but shall not include atomic fuels.

(v) **"The cost of fuel consumed"** shall mean the sums expended for **fuel** consumed plus the cost of any transport, handling, preparation or treatment incurred in connection with the delivery of the **fuel** to boiler hoppers or furnaces and in connection with the disposal of the products or residues of combustion, together with the proper proportion of salaries and wages and any contributions for pensions, superannuation and insurance of officers and servants attributable thereto and the amount of any rebate allowed by the suppliers from the price of heavy fuel oil delivered at the Generating Board's stations, such rebate being attributable only to a specific quantity of heavy fuel oil so delivered, less any sums received from the sale of any products or residues of combustion.

(vi) **"The number of kilowatt-hours supplied from generation in the Area"** in any period means the number of kilowatt-hours (being kilowatt-hours generated by the combustion of **fuel**) sent out from all the stations of the Generating Board in **the Area** in the period or **the number of kilowatt-hours supplied in the Area** in the period whichever is the less.

(vii) **"The number of kilowatt-hours supplied in the Area"** in any period shall mean the number of kilowatt-hours supplied in the period by the Generating Board to the relevant Area Board and to other consumers in **the Area.**

(viii) **"The number of kilowatt-hours imported into the Area"** means the amount if any by which **the number of kilowatt-hours supplied in the Area** exceeds **the number of kilowatt-hours supplied from generation in the Area.**

(ix) **"The residual cost per ton"** in any period shall mean the aggregate of—

(A) the quotient produced by dividing the amount by which **the national fuel cost per ton** in the period multiplied by the aggregate of **the number of kilowatt-hours supplied in the Area** of each Area Board in the period exceeds the aggregate of the respective products in the case of each Area Board of—(a) **the Area fuel cost per ton** in the period and (b) **the number of kilowatt-hours supplied from generation in the Area** in the period

by the aggregate of **the number of kilowatt-hours imported into the Area** of each Area Board in the period; and

(B) the sum of 6s. (six shillings).

(x) **"The national fuel cost per ton"** in any period shall be determined as follows: The total **cost of fuel consumed** in the period at all the Generating Board's stations shall be divided by the total number of tons of **fuel** so consumed and the cost per ton so obtained shall be multiplied by 11,000 and divided by the average gross thermal value of the **fuel** so consumed expressed in British thermal units per pound.

NARITE
The DIE METAL SUPERB

THE HEMISPERICAL SHAPES THAT FORM THE BODY OF THE **HOOVER CONSTELLATION CLEANER** ARE DEEP DRAWN BY NARITE DIES

PHOTOGRAPH BY COURTESY OF MESSRS. HOOVER LTD.

N. C. ASHTON LTD.
ST ANDREW'S ROAD
HUDDERSFIELD

TELEPHONE: HUDDERSFIELD 6263/4

ALLOTT BROS., and LEIGH LTD.

STRUCTURAL ENGINEERS
GENERAL PLATE WORKERS
BOILER REPAIRERS
STEEL STOCKHOLDERS

ICKLES FORGE, ROTHERHAM

Telephone: ROTHERHAM 4115-6
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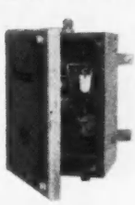
THE LEEDS & BRADFORD BOILER Co LIMITED
STANNINGLEY
★
AUTOCLAVES & VULCANISERS
with Pat. Quicklock door
CHEMICAL PLANT, CREOSOTING PLANT, VACUUM DRYING & IMPREGNATING PLANT, HYDRAULIC PRESSWORK.

CASTINGS
HIGH QUALITY ENGINEERING & MACHINE TOOL CASTINGS

HEAT & WEAR RESISTING UP TO 10 TONS
also in SPHEROIDAL GRAPHITE IRON & STEEL
MACHINING
R. GOODWIN & SONS (ENGINEERS) LTD.
IVY HOUSE FOUNDRY, HANLEY, STOKE-ON-TRENT Phone: Stoke-on-Trent 23612

LONDEX
Flowguard
WILL SAFEGUARD



This equipment consists of a flow transmitter in the pipeline connected to a simple relay unit. It is designed to prevent damage resulting from a failure in the flow of a vital liquid. Flowguard is available for ¼in. to 3in. bore pipes and for flow rates of from 0·5 to 100 gallons per minute.

REMOTE FLOW SWITCHES FOR

COOLING WATER, LUBRICANTS, OIL, CUTTING FLUIDS, ETC.

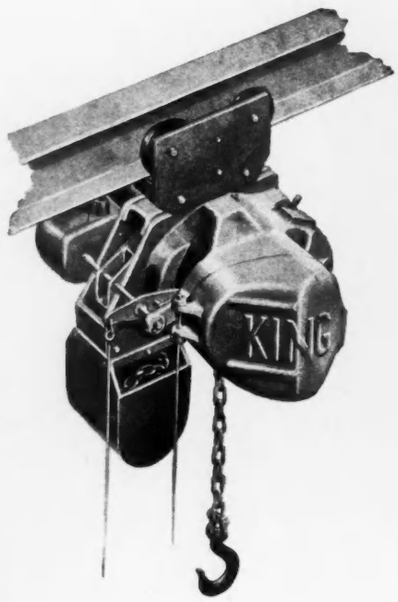
LONDEX LTD

Write for illustrated brochure No. 102.
Anerley Works, Anerley Road, London, S.E.20 Sydenham 3111

The finest hoists in the world are made by

KING

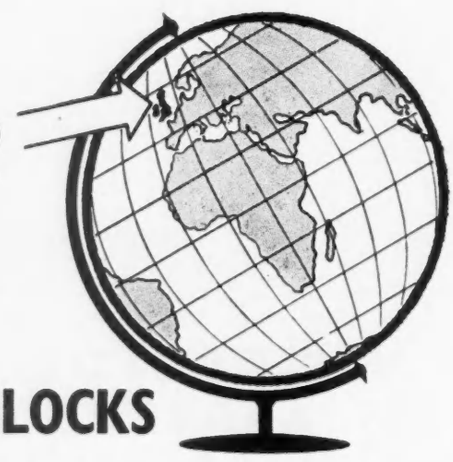
REGISTERED TRADE MARK



CAPACITIES
200 LBS. TO 13½ TONS

ALTERNATIVE SPEEDS AND CREEP SPEEDS *Flameproof and other special models available*

and they're made in Britain



Our representative will be pleased to call on you —anywhere in the world.

KING HOISTS & PULLEY BLOCKS

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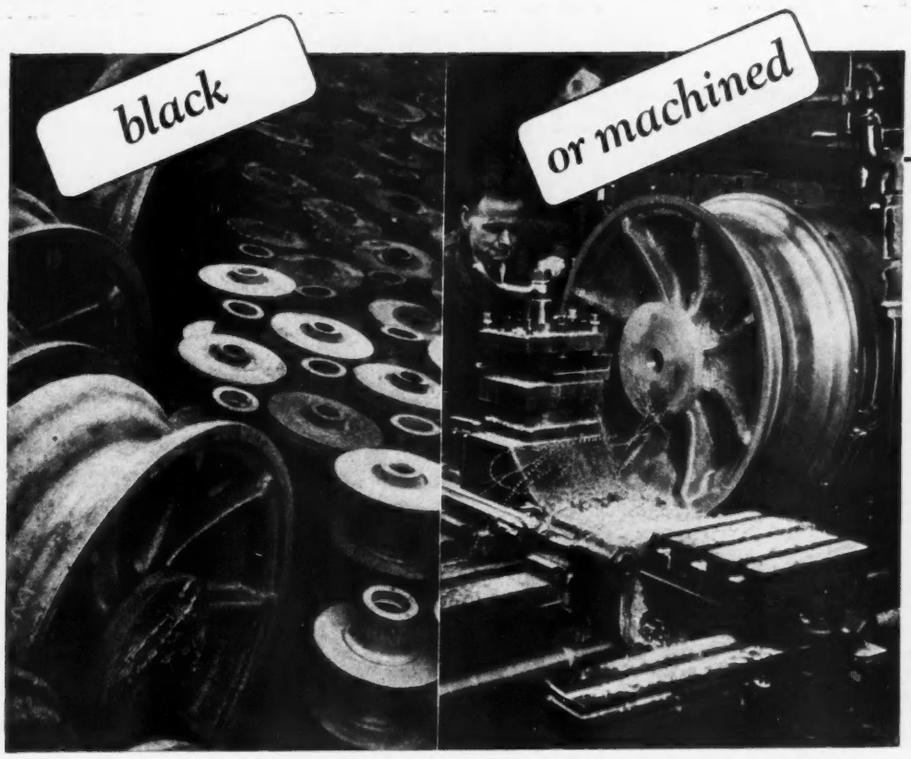
GEO. W. KING LTD., PB8 ARGYLE WORKS, STEVENAGE, HERTS. TEL: STEVENAGE 440



N S F

N.S.F. castings both black and machined are meeting the exacting requirements of the heavy motor industry, bearing manufacturers, and scores of other firms who are leaders in their respective fields.

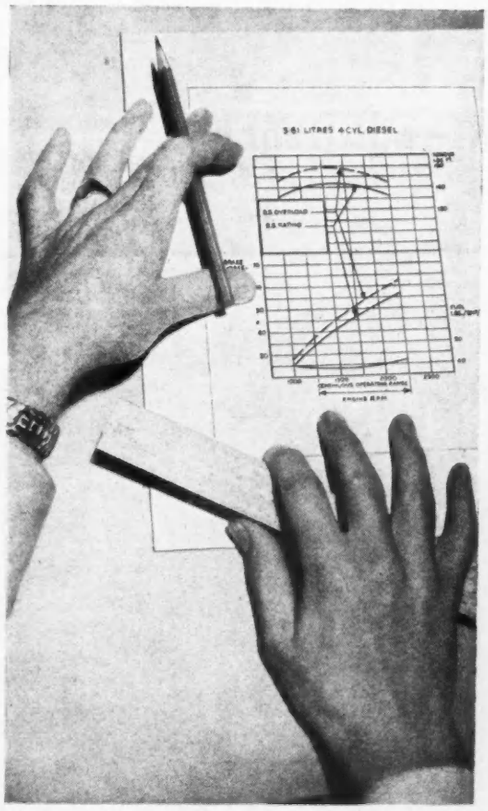
N.S.F. offer you the facilities of a modern steel foundry, also those of a well-equipped machine shop, plus 40 years experience in producing steel castings of unrivalled quality and finish.

If your product involves castings up to 3 tons N.S.F. can and would like to serve you.

Steel Castings

National Steel Foundry

(1914) LTD., KIRKLAND WORKS, LEVEN, FIFE. PHONE LEVEN 693, LONDON OFFICE, ALEXANDRA HOUSE, KINGSWAY W.C.2



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Our range of industrial engines are a practical proposition for many types of industrial equipment . . . **compressors, cranes, pumps, contracting equipment, earth borers, generators, railcars, welding plant, works trucks, tractors and conversions.** Simple design, modern flow-line production methods and common interchangeable parts contribute to the low cost of these high efficiency engines. And remember, every engine is fully backed by a World-wide Parts and Service Organisation. Take your choice from a wide power range . . . Diesel 20 to 86 b.h.p. and Petrol 11 to 87 b.h.p. (12-hr. rating).

DIESEL ECONOMY—have you considered the replacement of existing power units in your equipment and trucks with the famous 4D Diesel engine? You'll have the unique advantages of economy, long-life and low running costs . . . plus the best service in the World!

Wherever you are, whatever your problem,

FORD

MOTOR COMPANY LIMITED ENGLAND

are at your service

For further details of our

INDUSTRIAL ENGINES

and the equipment they power, send the coupon to your nearest Ford Dealer or direct to

Please send me technical brochures of your *PETROL/DIESEL Industrial Engines. The maximum B.H.P. required is .....at..... R.P.M. Also, Please send details of the following equipment powered by your engines.

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FORD MOTOR COMPANY LTD · PARTS DIVISION (G51) · AVELEY DEPOT · SOUTH OCKENDON · ROMFORD · ESSEX · ENGLAND

Manufacturers of . . .

GUEST KEEN IRON & STEEL COMPANY

- **STEEL** BLOOMS · BILLETS SLABS · SECTIONS COLLIERY ARCHES · PIT PROPS ROOFING BARS · LIGHT RAILS SLEEPERS and HAMMERLOCK STRUTS
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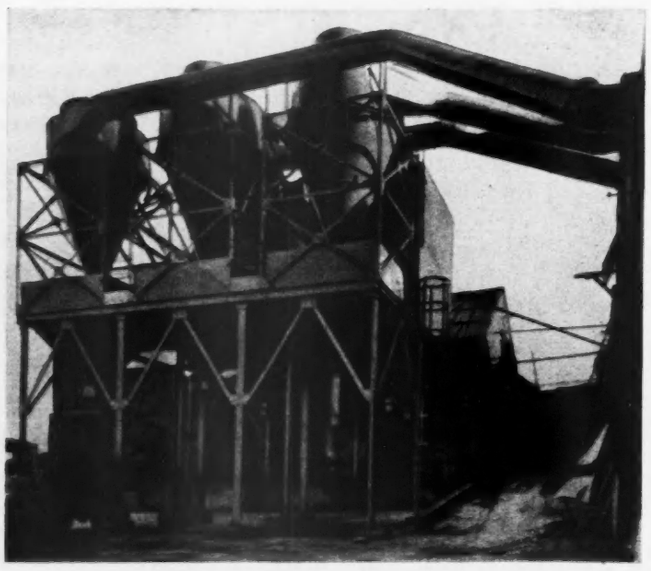
GUEST KEEN IRON & STEEL CO. LTD.

East Moors, Cardiff.

Telephone : Cardiff 33151 Telegrams : "Billets, Cardiff"

Specify *"Tornado"* **FAN ENGINEERING EQUIPMENT**

MORE AND MORE PLANT for fume and dust extraction, cooling, drying and other applications is being installed incorporating all types of 'Tornado' fan engineering equipment. The success with which such plants are operating throughout a wide range of industry results from the combination of our own extensive experience and the close collaboration of leading contracting and consulting engineers.



DUST EXTRACTION
Foundry dust exhaust plant for Sinclair Iron Co. Ltd, by whose courtesy this photograph is published.

When faced with any industrial problem of movement or treatment of air or gases, specify 'Tornado' equipment by

KEITH BLACKMAN LTD

MILL MEAD ROAD · LONDON · N17

Branch Offices : Birmingham · Bristol · Glasgow · Leeds Leicester · Manchester · Newcastle-upon-Tyne.

836

CLASSIFIED ADVERTISEMENTS

AGENCIES · DIRECTORS · PARTNERSHIPS · SITUATIONS VACANT · EDUCATIONAL PATENTS · BUSINESS OPPORTUNITIES · MISCELLANEOUS · PUBLIC APPOINTMENTS BUSINESSES and PREMISES · TENDERS

Lineage Rate. 4/- per line of approximately 6 words. Minimum 16/-.

Inch Rate. 48/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

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Series Discounts. For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

Run-On and Semi-Displayed Styles. Both these styles are available for single column width advertisements of any depth up to 12 inches.

Displayed and Illustrated Styles. The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

Use of Box Number. 2/- which includes forwarding of replies.

Copy Dates. "Run-on" and "Semi-displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

***Advertisements for publication should be addressed to:*—Classified Advertisement Dept., "The Engineer", 28 Essex Street, Strand, London, W.C.2.**

Urgent advertisements may be telephoned to CENtral 6565

PUBLIC APPOINTMENTS

NIGERIAN COLLEGE OF ARTS, SCIENCE AND TECHNOLOGY

(Principal: C. A. HART, C.M.G., T.D., D.Sc., Ph.D., M.I.C.E., M.I.Mech.E., F.R.I.C.S., A.M.I.Struct.E.)

SENIOR TECHNOLOGISTS OR TECHNOLOGISTS

Applications are invited for SENIOR TECHNOLOGISTS or TECHNOLOGISTS for the engineering laboratory and workshops for students preparing for University of London B.Sc. (Eng.) in Special Relationship.

Candidates should possess relevant professional qualification, but in special cases wide, responsible experience in well-known laboratory considered instead. Special skills, viz. glass-blowing, slide preparation, &c., should be stated. The standard should preferably be at least that of Final City and Guilds. Duties include general charge and supervision of laboratory, full assistance to academic staff and training of subordinate staff. Appointment on Chief Technologist grade may be available in case of exceptionally well qualified and experienced candidate.

Contract Salary Scales: Technologist, £654–£1116 p.a.; Senior Technologist, £990–£1260 p.a.; Chief Technologist, £1164–£1524 p.a., all plus inducement addition of £180–£300 p.a. for overseas appointees and gratuity at £25 or £37 10s. for each completed 3 months' residential service. Entry point according to qualifications and experience.

Partly furnished quarters at one-twelfth basic salary rental. Tours 10–18 months, but leave normally taken in long vacation. Children's U.K. maintenance grant up to £150 p.a. and passages assistance.

Applications (6 copies), giving age, qualifications, experience and names of 3 referees, should be sent to The Council for Overseas Colleges, 12, Lincoln's Inn Fields, London, W.C.2, by 10th April, 1959.

E5219

UNIVERSITY OF BIRMINGHAM

WILMOT BREEDEN RESEARCH FELLOWSHIP, 1959

Applications are invited for a RESEARCH FELLOWSHIP to be held in association with the University of Birmingham. The value of the Fellowship, which is for a two-year term, is £1000 per annum.

A candidate for the Fellowship should normally have had two or three years' research or industrial experience. He must be acceptable to the University and would be expected to have an Honours Degree of a University in the British Commonwealth, a Diploma in Technology or an equivalent qualification.

The Wilmot Breeden Fellow will engage in an enterprise of such a character as to require the facilities both of the University and the Company, and his time will be divided between the two. The activities with which the Company is especially concerned include Mechanisms, Electro-Chemistry, Metal Finishing, Metallurgy, Metal Formation, Hydraulics, Electronics.

Full details may be obtained on application to the Secretary, Wilmot Breeden, Limited, Amington Road, Birmingham, 25. Final applications must be received by the Secretary before 1st May, 1959.

E5166

ROYAL NAVAL COLLEGE, GREENWICH

PROFESSORS

(a) PROFESSOR OF APPLIED MECHANICS; (b) PROFESSOR OF PHYSICS AND ELECTRICAL ENGINEERING. These 2 pensionable posts for men at least 31 on January 1, 1959, will fall vacant in September, 1959, due to retirements on age grounds. Qualifications: Post (a) high academic qualifications in engineering, with teaching and research or industrial experience; Post (b), high academic qualifications in Physics or Electrical Engineering, with teaching and research or industrial experience. For post (b) experience in electronics, electrical engineering practice or radio engineering is desirable. Duties: lecturing, organisation of instruction, supervision of laboratories, and (in post (a)), development of new guided weapons laboratory. Secondment from Scientific Civil Service considered. Salary £2500–£2800. Single accommodation may be provided.—Write, Civil Service Commission, Burlington Gardens, London, W.1, for application form, quoting 4955/59. Closing date 8th April, 1959.

E5198

PUBLIC APPOINTMENTS

KENT EDUCATION COMMITTEE

NORTH-WEST KENT COLLEGE OF TECHNOLOGY

MECHANICAL ENGINEERING DEPARTMENT

APPOINTMENTS

Applications are invited for the following appointments:—

ASSISTANT (GRADE B), to teach Workshop Technology in the City and Guilds Machine Shop Engineering and the National Certificate courses. Other subjects according to qualifications.

ASSISTANT (GRADE B), to teach Mathematics up to Ordinary National Certificate standard. Ability to teach English or Science an additional recommendation.

LECTURER (Lecturer Grade), to teach Strength of Materials and Theory of Machines to Higher National Certificate level. Qualifications in at least one of the following also desirable:—Structures, Hydraulics, Metallurgy.

Salary scales are as follows:—

Assistant, Grade B (man), £650 by £25 to £1025; Lecturer (man), £1200 by £30 to £1350.

Plus 5 per cent. on all grades. Forms of application and further details obtainable from the Principal at the College, Miskin Road, Dartford. (Please state post in which you are interested.) E5193

NORTH RIDING EDUCATION COMMITTEE

CLEVELAND TECHNICAL COLLEGE, REDCAR

APPOINTMENTS IN ENGINEERING DEPARTMENT

Applications are invited for the following posts to take effect from September 1st, 1959.

ENGINEERING DEPARTMENT

1. ASSISTANT, Grade B, for Workshop Engineering Subjects. Special responsibility allowance £100 p.a. Good industrial experience essential.
2. ASSISTANT, Grade B, for Mechanical Engineering to O.N.C.
3. ASSISTANT, Grade B, for Mechanical Engineering and Machine Shop subjects.
4. ASSISTANT, Grade B, for Electrical subjects.
5. ASSISTANT, Grade B, for Machine Shop Practice to Final City and Guilds.
6. ASSISTANT, Grade B, for work with full-time preliminary engineering groups.
7. ASSISTANT, Grade A, for Machine Shop Practice.

Forms and particulars obtainable from me on receipt of stamped, addressed envelope. Completed forms to be returned by April 3rd, 1959.

F. BARRACLOUGH.

County Hall,
Northallerton. E5250

COVENTRY TECHNICAL COLLEGE

(Principal: A. J. RICHMOND, B.Sc.(Eng.) (Lond.), Ph.D., M.I.Mech.E.).

LECTURERS

Applications invited for following full-time posts, duties to commence as soon as possible:

(1) LECTURER IN MECHANICAL ENGINEERING with special knowledge of Strength of Materials, or Theory of Machines, or Applied Thermodynamics.

(2) LECTURER IN AERONAUTICAL ENGINEERING with special knowledge of Applied Aerodynamics and/or Aircraft Performance.

Applicants should be University Graduates and have had industrial experience. At least Graduate membership of appropriate professional body is required. Previous teaching experience is not essential. Burnham Technical Scale Salary (Men) £1260 to £1417 10s. per annum. Women receive slightly less at present but equal pay will apply by 1961.

Further particulars and application forms from the Principal, Butts, Coventry, to whom applications should be submitted by 16th April, 1959.

W. L. CHINN,
E5240 Director of Education.

PUBLIC APPOINTMENTS

WARRINGTON EDUCATION COMMITTEE

TECHNICAL COLLEGE

ASSISTANTS

Required for 1st September, 1959:

ASSISTANT GRADE A in MECHANICAL ENGINEERING, mainly to teach subjects in the National Certificate courses.

ASSISTANTS, GRADE A (TWO) in MACHINE SHOP ENGINEERING to teach subjects mainly in the City and Guilds courses.

ASSISTANT, GRADE A in CARPENTRY AND JOINERY to teach subjects in the City and Guilds courses, and also to assist in the preliminary technical courses.

ASSISTANT, GRADE A, in ENGLISH, to teach mainly in the professional, commercial and secretarial courses.

Salary will be according to Burnham scale, i.e. £498 15s. by £26 5s. to £945 per annum with additions for approved qualifications and training. Approved industrial experience qualifies for increments on the scale.

Application forms and further particulars may be obtained from the Chief Education Officer, Education Office, Sankey Street, Warrington, upon receipt of a stamped, addressed foolscap envelope and should be returned as soon as possible. E5251

BEDFORDSHIRE EDUCATION COMMITTEE

MANDER COLLEGE

APPOINTMENTS

Applications invited for the following appointments at Mander College, Bedford, as from 1st September, 1959.

(a) Department of Engineering:

SENIOR LECTURER IN MECHANICAL ENGINEERING for H.N.C. courses in Theory of Machines and Strength of Materials. University degree or equivalent qualification essential.

ASSISTANT, GRADE B, in DRAWING and SCIENCE for O.N.C. and C.G.L.I. courses.

ASSISTANT, GRADE A, in WORKSHOP PRACTICE, mainly for C.G.L.I. courses.

(b) Department of Science:

SENIOR LECTURER IN MATHEMATICS for H.N.C. and G.C.E. advanced level courses. Honours degree in Mathematics expected.

Forms of application and further particulars obtainable from the Principal.

T. S. LUCKING,
E5248 Director of Education.

SEVERALLS HOSPITAL, COLCHESTER, ESSEX

SUPERINTENDENT ENGINEER

Applications are invited for the post of SUPERINTENDENT ENGINEER at the above Mental Hospital (1983 beds). Salary at present £1080 by £30 (1) by £35 (2) by £40 (1) by 45 (1) to £1265 per annum, plus percentage gratuity for hours worked in excess of 38 per week. National Health Whitley Council Conditions of Service.

Unless eligible for promotion through previous Health Service experience, the successful candidate should have passed an examination in engineering technology and hold one of the following qualifications:—

M.T.C.A. First Class Certificate of Competency in Marine Engineering (or equivalent Naval Certificate).

M.T.C.A. Certificate of Service as First Class Engineer.

City and Guilds Full Technological Certificate in Plant Engineering (First Class).

A thorough knowledge of hospital boiler plants, engineering and electrical services is necessary, together with experience of building maintenance work. The successful applicant will be required to act as Clerk of Works for building works.

A four-bedroomed house will be available at a moderate rental, where the Superintendent Engineer will be required to reside.

Applications, stating age, qualifications and experience, together with the names of three referees, should be sent to the Group Secretary within 21 days of the appearance of this advertisement. E5205

PUBLIC APPOINTMENTS

CENTRAL ELECTRICITY GENERATING BOARD

NORTH EASTERN DIVISION

STEAM TESTING DEPARTMENT

SECOND ASSISTANT ENGINEER

Applications are invited for the appointment of a SECOND ASSISTANT ENGINEER in the Steam Testing Department with Headquarters at Dunston, to control a small section investigating the thermal performance and operating characteristics of a wide variety of modern steam plant.

The work demands considerable initiative, and offers experience of testing techniques in an interesting field.

Applicants should be Corporate Members of the Institution of Mechanical or Electrical Engineers, and should have previous plant testing experience. A knowledge of power station operation will be considered an advantage.

The salary for the appointment will be in accordance with the National Joint Board Agreement, Schedule "B," Grade 4 (£1180–£1410), and will commence at a point commensurate with qualifications and experience.

Forms of application may be obtained from Divisional Establishments Officer, Central Electricity Generating Board, North Eastern Division, Carliol House, Newcastle upon Tyne, 1, to whom they should be returned to arrive not later than 17th April, 1959.

E5236

ATOMIC WEAPONS RESEARCH ESTABLISHMENT

ALDERMASTON, BERKS

ENGINEER

ENGINEER required by the Atomic Weapons Research Establishment, Aldermaston, Berks, to take charge of an Instrument Section which is responsible for the maintenance, installation, servicing and testing of works instrumentation, including electronic, electrical and pneumatic systems.

A recognised engineering apprenticeship or equivalent training is required and Corporate Membership of a Senior Engineering Institution. Several years' practical experience is necessary in the instrumentation field in large works or preferably in Chemical Plants.

Salary. This will be assessed in one of the following scales according to qualifications and experience. £1345 to £1800. £845 (at age 25) to £1150 (at age 34 or over) to £1315.

Contributory Superannuation scheme. A house or alternatively substantial assistance with house purchase will become available for married officers living beyond daily travelling distance.

Postcards for application forms to the Senior Recruitment Officer at above address. Please quote Ref. 2193/25. E5185

THE TOWERS HOSPITAL, HUMBERSTONE, LEICESTER

ASSISTANT ENGINEER

ASSISTANT ENGINEER required at The Towers Hospital, Humberstone, Leicester (1024 beds).

Applicants must have served a recognised engineering apprenticeship and have a sound knowledge and experience of steam boiler plants and auxiliaries, heating and domestic hot water apparatus and electrical installations.

Candidates should possess the Ordinary Engineering Certificates in Mechanical Engineering (including heat engines and the principles of electricity), or an equivalent qualification.

Salary and conditions of service for this post, which is superannuable, will be in accordance with the Whitley Council recommendations, £605 by £25 (3) by £30 (2) to £740 per annum.

The successful candidate will be required to reside near the hospital in an unfurnished house, which will be provided at an appropriate rental.

Applications, giving details of age, qualifications and experience, and quoting the names of three persons to whom reference may be made, should be forwarded to The Hospital Secretary, The Towers Hospital, Humberstone, Leicester, by the 6th April, 1959. E5215

Classified Advts. continued on page 130

PUBLIC APPOINTMENTS

ROYAL NAVAL SCIENTIFIC SERVICE

SENIOR SCIENTIFIC OFFICERS AND SCIENTIFIC OFFICERS

Royal Naval Scientific Service requires SENIOR SCIENTIFIC OFFICERS and SCIENTIFIC OFFICERS for Establishments in London area, Baldock, Portsmouth, Portland, Poole and Rosyth. Main requirements are for PHYSICISTS, MECHANICAL ENGINEERS, ELECTRONIC ENGINEERS and MATHEMATICIANS in areas specified. The following particular vacancies also exist: Mathematician: for applied research of basic nature on stability of underwater vehicles; knowledge of theoretical hydrodynamics and theory of control systems an advantage: London area. Mechanical Engineer: with sound knowledge of basic principles of thermo and fluid dynamics, to carry out research programme in a particular field of applied hydrodynamics. Experience in modern methods of design and research on axial flow compressors, turbines or pumps an advantage; London area. Mechanical Engineers: for design and development of underwater devices; Portland area. Physical Chemist: with specialised knowledge of rubber technology: Poole area. Chemists: Physical and Inorganic: Poole, Baldock and London areas. Candidates must normally be natural born British subjects of natural born British parents, with First or Second Class Honours Degrees. S.S.O.s must have had three years' post-graduate experience and be not less than 26 years of age.

Salaries (men): S.S.O., £1233–£1460; S.O., £655–£1150 (London)—somewhat lower in provinces. Appointments are unestablished (with F.S.S.U. benefits), but opportunities may occur for those between ages of 21 and 32 to compete for established posts.

Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1. (quote A.500/8A). E5161

FEDERAL GOVERNMENT OF NIGERIA

PUBLIC WORKS DEPARTMENT

MECHANICAL ENGINEER

To supervise and control the maintenance and repairs to all types of equipment, including road-making plant, heavy earth-moving plant, general contractors' plant, waterworks installations and vehicles.

Contract appointment for one tour of 12–18 months in the salary range £1416–£2166 p.a. Gratuity of £37 10s. for each 3 months' satisfactory service. Quarters, if available, at low rental; free passages; allowance of £75 p.a. for each of two children maintained in U.K.; generous leave; free medical attention.

Candidates, between 25 and 50 years of age, must have passed, or be exempt from Parts I and II of the examination for A.M.I.Mech.E. They should have had at least 3 years' experience of mechanical engineering work and gained experience in diesel and/or petrol engines, and drawing, machine and workshops practice. Knowledge of pumping and refrigerating plant, heavy earth-moving equipment and electric motors, &c., would be an advantage.

Write, Director of Recruitment, Colonial Office, S.W.1, giving briefly age, qualifications and experience, quoting BCD 112/14/010. E5230

SURREY COUNTY COUNCIL

HIGHWAYS AND BRIDGES DEPARTMENT

APPOINTMENTS

Highways and Bridges Department have vacancies for:

CIVIL ENGINEERS:

(a) Grade APT IV–V.—Applicants should be qualified Civil Engineers with experience in soil mechanics and testing of materials required for highway construction.

(b) Grade APT IV.—Applicants should have experience in river improvement works, including design of reinforced concrete bridges, culverts, retaining walls, &c.

(c) Grade "Special."—Appointments provide first class experience in Bridge Design, Road Layout and Construction.

ENGINEERING ASSISTANTS:

(d) Grades APT I–II.—Appointments provide suitable experience for those wishing to proceed to a professional qualification.

SALARY RANGES:

(a) Between £1025 and £1325; (b) £1025 and £1175; (c) £750 and £1030, and (d) £575 and £845 per annum plus London Allowance.

Particulars and forms of application returnable by 11th April, 1959, from County Engineer, County Hall, Kingston-upon-Thames. E5241

HACKNEY BOROUGH COUNCIL

ENGINEERING ASSISTANT

ENGINEERING ASSISTANT required by Hackney Borough Council, Grade A.P.T. I/II (£575–£845 per annum); London Weighting allowance £30 per annum, at age 26. Commencing salary according to training, qualifications and experience.

Apply, Town Clerk, Town Hall, Hackney, E.8, for application form returnable by 9 a.m., 6th April, 1959. E5247

PUBLIC APPOINTMENTS

UNITED KINGDOM ATOMIC ENERGY AUTHORITY INDUSTRIAL GROUP

RESEARCH AND DEVELOPMENT LABORATORIES AT SPRINGFIELDS, SALWICK, PRESTON

MECHANICAL ENGINEERS

Mechanical Engineers are required by the United Kingdom Atomic Energy Authority, Industrial Group, for the Research and Development Laboratories at Springfields, Salwick, Preston, to work in a Metallurgical Laboratory in which development and evaluation of fabrication techniques for beryllium with particular reference to the application of fine metal to fuel element components for nuclear reactors is undertaken.

The successful candidates will be concerned with the co-ordination of engineering requirements for the laboratory and design or supervision of design of items of experimental plant or engineering equipment required by scientific staff. Discussions with contractors concerning matters of design will be involved.

A recognised engineering apprenticeship and corporate membership of the Institution of Mechanical Engineers or equivalent are essential. Experience of design work on development projects is required.

Salary between £845 (at age 25) and £1800 according to qualifications and experience.

Contributory Superannuation. Staff housing scheme.

Send postcard for application form, quoting reference 2934/J1 to Recruitment Officer, U.K.A.E.A. I.G.H.Q., Risley, Warrington, Lancashire.

Closing Date: March 30th, 1959. E5187

CITY OF LIVERPOOL

WATER DEPARTMENT

APPOINTMENTS

Applications are invited for the following appointments:

1. ASSISTANT MECHANICAL ENGINEER. Salary £1025–£1175 p.a. (APT. IV). Applicants must be Associate members of the Institution of Mechanical Engineers.

2. ENGINEERING ASSISTANT—DRAWING OFFICE. Mains Section. Salary £750–£1030 p.a. (N.J.C. Scale.) Applicants must have passed the final examination or be a graduate member of the Institution of Civil Engineers, or be a university graduate assistant.

3. TWO CIVIL ENGINEERING ASSISTANTS. Salary £575–£1030 p.a. (A.P.T. I—N.J.C. Scale.) Applicants must either have been trained as a Civil Engineer and have passed Parts I and II of the Examination of the Institution of Civil Engineers (or hold the necessary exempting qualifications), or hold a suitable degree of a British University.

Experience in the construction or design of works of water supply would be an advantage.

Application forms returnable by 31st March, 1959, from the Water Engineer, 55, Dale Street, Liverpool, 2. The appointments are superannuable and subject to the Standing Orders of the City Council. Canvassing disqualifies.

THOMAS ALKER,
Town Clerk.

(I5573) E5249

MINISTRY OF SUPPLY

LONDON

ASSISTANT TECHNICAL COST OFFICERS

Ministry of Supply require ASSISTANT TECHNICAL COST OFFICERS in London to prepare estimates of prime cost of manufacture of engineering products. These duties normally involve a fair amount of travelling. Qualifications: recognised engineering apprenticeship; O.N.C., appropriate C. and G. Final Certificates, or equivalent qualification desirable. Good practical experience in rate-fixing, operational planning and prime cost estimating of engineering products. Vacancies in sections concerned with mechanical and electrical productions, the manufacture of electronic equipments and work which requires good machine shop experience. Candidates selected for interview may be required to carry out a test of ability to perform these duties. Salary: £900–£1065 p.a.—Application forms from Ministry of Labour and National Service, Professional and Executive Register, Atlantic House, Farringdon Street, London, E.C.4, quoting PE 368. Only persons selected for interview will be advised. E5197

CITY OF NOTTINGHAM

WATER DEPARTMENT

PERMANENT APPOINTMENT—CIVIL ENGINEERING ASSISTANT

Applications are invited from Engineering Graduates and/or Graduate Members of the Institution of Civil Engineers with at least 5 years' satisfactory experience for the permanent, pensionable appointment of a CIVIL ENGINEERING ASSISTANT. Salary, dependent upon qualifications and experience, in the Special Grade for Engineering and Surveying Assistants (£750 by £40 to £1030).

Applications, with names of two persons to whom reference may be made, to Engineer and General Manager, Water Department, Castle Boulevard, Nottingham, by 31st March.

T. J. OWEN,
Town Clerk.

Guildhall,
Nottingham. E5196

PUBLIC APPOINTMENTS

Atomic Energy Research Establishment

HARWELL

A TECHNICAL OFFICER is required, to be responsible for the testing of large automatically controlled pumping equipment, large vacuum vessels and ancillary equipment which comprise the vacuum system of a large particle accelerator. An engineering apprenticeship, experience in erection, inspection, maintenance or performance testing of high vacuum equipment and control gear and ability to supervise a team of skilled craftsmen are required.

Salary: £905 (at 30) to £1085. Housing and superannuation schemes.

Please send a POST CARD to the Group Recruitment Officer (1377/25), U.K.A.E.A., A.E.R.E., Harwell, Berks., for details.

E5191

LIVERPOOL REGIONAL HOSPITAL BOARD

PRINCIPAL ASSISTANT ENGINEER II (MECHANICAL)

Applications invited from suitably qualified persons for the permanent pensionable appointment of PRINCIPAL ASSISTANT ENGINEER II (MECHANICAL) on the staff of the Regional Engineer.

Salary Scale, £1195 rising to a maximum of £1420.

The person appointed will be required to take charge of the Mechanical Section of the Department. Applicants should hold Corporate Membership of I.Mech.E., and have had considerable experience on heating and ventilating schemes, kitchen and laundry layouts, fuel efficiency and steam boiler plant installations. Experience on hospital installations desirable.

Applications, stating age, qualifications, experience, present and previous posts, with the names and addresses of three referees (2 technical), to reach me at 55, CASTLE STREET, LIVERPOOL, 2, by 3rd April, 1959.

VINCENT COLLINGE,
E5172 Secretary to the Board.

TENDERS

BOROUGH OF CHESTERFIELD

SEWERAGE

CONTRACT NO. 6

TENDERS are invited for the CONSTRUCTION of approximately 1750 lineal yards of S.G.W. SEWER, ranging from 9in. to 18in. in diameter, together with 25 BRICK and CONCRETE MANHOLES. The contract will also include DEMOLITION of approximately 100 yards of EXISTING SEWERS and about 8 MANHOLES.

General conditions of contract, specification, bills of quantities and drawings may be obtained from the Council's Consulting Engineers, Messrs. J. D. and D. M. Watson, M.I.C.E., 67, Tufton Street, Westminster, S.W.1, on and after Monday, 6th April, 1959, on payment of ten guineas deposit, refundable only to contractors who submit bona-fide Tenders and return all documents and drawings on or before the last day for receipt of Tenders. Cheques should be made payable to J. D. and D. M. Watson or order.

The Council does not bind itself to accept the lowest or any Tender.

Tenders must be delivered in a plain package endorsed "Tender for Contract No. 6," and delivered to the undersigned by noon on Monday, 4th May, 1959.

RICHARD CLEGG,
Town Clerk.

Town Hall,
Chesterfield,
9th March, 1959. E5194

GOVERNMENT OF MALTA

WATER SUPPLY

TENDERS are invited by the Maltese Government for the Supply and Erection of WATER PUMPING PLANT for three pumping stations on the island of Malta. The plant required consists of a total number of five electro-submersible pumping sets each rated at about 8000 g.p.h., complete with motors, starters, switchgear, instruments, pipework, cabling, &c.

Tender documents and drawings may be obtained at the office of The Treasurer, The Palace, Valetta, Malta, or at the office of the Engineers, Messrs. Binnie, Deacon and Gourley, Artillery House, Artillery Row, Westminster, London, S.W.1, on payment of Two Pounds for each copy of the documents, on or after Monday, 23rd March, 1959.

Sealed Tenders in duplicate in a plain envelope endorsed "Tender for Water Pumping Plant, &c., for Binjemma, Falka and Mgarr" shall be delivered at the office of The Treasurer, The Palace, Valetta, Malta, not later than 10 a.m. on Tuesday, 5th May, 1959.

The Maltese Government do not undertake to accept the lowest or any Tender, and will not defray any expenses incurred by tenderers who will, nevertheless, be presumed to have acquainted themselves fully with the site and conditions of the work.

THE TREASURER,
E5184 Malta.

TENDERS

RAND WATER BOARD

JOHANNESBURG, SOUTH AFRICA

CONTRACT NO. 919

SUPPLY AND DELIVERY OF 84-INCH INTERNAL DIAMETER PIPE, EXCAVATION OF PIPE TRENCHES, &c., AND LAYING AND JOINTING OF PIPE FOR A PIPELINE APPROXIMATELY 62,500 FEET IN LENGTH

Tenders are hereby invited for the supply and delivery of the above-mentioned pipe, excavation of pipe trenches, &c., and laying and jointing of a pipeline under Contract No. 919.

Copies of the contract documents may be obtained from the Chief Engineer (Mr. C. P. Robinson, B.Sc., M.I.C.E., M.(S.A.)I.C.E.), 3, Fraser Street, P.O. Box 1127, Johannesburg, or from Ranald J. Harvey and Partners, 34, Victoria Street, Westminster, London, S.W.1, England, on payment of a deposit of £5 in respect of the first copy and £2 for each additional copy.

Deposits for documents will be refunded on receipt of a bona fide tender or, in the event of failure to submit a tender, on return of the documents within one month of the date tenders are opened.

Tenders endorsed "CONTRACT No. 919—TENDER FOR 84-INCH PIPELINE" must be sealed and delivered to the undersigned before NOON on WEDNESDAY, 29th JULY, 1959.

The Board does not bind itself to accept the lowest or any tender.

N. McMURRAY,
Secretary.

3, Fraser Street,
P.O. Box 1127,
Johannesburg,
South Africa,
6th March, 1959.
Notice No. 1077. E5183

KINGDOM OF THAILAND

ROYAL IRRIGATION DEPARTMENT

BANGKOK, THAILAND

The Royal Irrigation Department of the Kingdom of Thailand requests sealed wirtten BIDS for FURNISHING AND DELIVERING c.i.f. Bangkok Wharf for the Yanhee Multipurpose Project, Kingdom of Thailand, in accordance with the contract documents, including Invitation for BIDS—No. YS-2-5, the following EQUIPMENT:

FOUR (4) 1·25 metre × 1·80 metre HIGH-PRESSURE GATES and TWO (2) CONDUIT LININGS, including Controls and Accessories.

Bids will be opened at 10 a.m., 14th May, 1959. Copies of contract documents, including invitation for Bids—No. YS-2-5, may be obtained by qualified Bidders on written request on Bidder's letterhead, addressed to Royal Irrigation Department, Attention: Thai Liaison Engineer, c/o Engineering Consultants, Inc., 1940 West Mississippi Avenue, Denver 23, Colorado, U.S.A. Each request must be accompanied by a cheque or money order, payable to the Royal Irrigation Department, in the amount of U.S. $10.00 for each copy of the contract documents requested.

M. L. XUJATI KAMBHU,
Director General,
E5225 Royal Irrigation Department.

INDIA STORE DEPARTMENT

The Director General, India Store Department, Bromyard Avenue, Acton, W.3, invites TENDERS for the following:—

(a) BARREL RIFLING MACHINE, 2500mm. max. rifling length by 13 to 50mm. dia. bore by 300mm. min. rifling pitch.

(b) HONING MACHINE, 4500mm. max. work length by 3700mm. max. stroke by 20 to 105mm. honing dia.

Specifications, drawings, &c., relative to the above enquiries can be obtained from the Co-ordination Department, India Store Department, Bromyard Avenue, Acton, W.3, at 10 shillings per Tender enquiry. Tenders are due for return to India Store Department at the above address by 2 p.m. on Monday, 4th May, 1959.

In your application for Tenders, please quote reference No. 2032/58/SSB/ENG.3 for (a) and 2033/58/SSB/Eng.3 for (b). E5227

TENDERS

KINGDOM OF THAILAND

ROYAL IRRIGATION DEPARTMENT

BANGKOK, THAILAND

The Royal Irrigation Department of the Kingdom of Thailand requests sealed written BIDS for FURNISHING and DELIVERING c.i.f. Bangkok Wharf for the Yanhee Multipurpose Project, Kingdom of Thailand, in accordance with the contract documents, including invitation for BIDS—No. YS-1-2, the following EQUIPMENT :

MECHANICAL REFRIGERATION EQUIPMENT consisting of Water Chilling Units having a combined capacity of 600 tons refrigeration, chip ice-making units having a combined capacity of 200 short tons of ice per day, cooling tower, chip ice conveyor, complete with accessories, spare parts and tools.

Bids will be opened at 10 a.m., 28th May, 1959. Copies of contract documents, including invitation for Bids—No. YS-1-2, may be obtained by qualified Bidders on written request on Bidder's letterhead, addressed to Royal Irrigation Department, Attention : Thai Liaison Engineer, c/o Engineering Consultants, Inc., 1940 West Mississippi Avenue, Denver 23, Colorado, U.S.A. Each request must be accompanied by a cheque or money order, payable to the Royal Irrigation Department, in the amount of U.S. $10.00 for each copy of the contract documents requested.

M. L. XUJATI KAMBHU,
Director General,
E5224 Royal Irrigation Department.

COUNTY BOROUGH OF GRIMSBY

EDUCATION COMMITTEE

GRIMSBY COLLEGE OF FURTHER EDUCATION

SUPPLY OF ENGINEERING EQUIPMENT

TENDERS are invited for the SUPPLY of ENGINEERING EQUIPMENT to the Grimsby College of Further Education. Further details may be obtained from the undersigned, to whom Tenders, when completed, should be returned in the envelope which will be provided, not later than 10 a.m. on Monday, 13th April, 1959.

The Committee do not bind themselves to accept the lowest or any Tender.

R. E. RICHARDSON,
Director of Education.

Education Office,
Eleanor Street,
Grimsby,
Lincs. E5233

EDUCATIONAL

CHELSEA COLLEGE OF SCIENCE AND TECHNOLOGY

MANRESA ROAD, LONDON, S.W.3

DEPARTMENT OF MATHEMATICS

The next SANDWICH COURSE in Applicable Mathematics (of four years' duration) will begin in September, 1959. The course is recognised for the award of the Diploma in Technology. State Scholarships, Technical State Scholarships, and Local Education Authority awards may be held by students attending this course.

Enquiries are invited from students and also from industrial organisations, schools and further education establishments which may wish to recommend students for the course.

N. M. H. LIGHTFOOT, M.A., F.R.S.E.,
E9915 E Principal.

INSTITUTION OF ELECTRICAL ENGINEERS

SCHOLARSHIPS

The Council of The Institution of Electrical Engineers will consider for award this year THREE RESEARCH SCHOLARSHIPS, TWO GRADUATE SCHOLARSHIPS and SEVEN STUDENT SCHOLARSHIPS for study at universities and technical colleges. Research Scholarships : value £100–£500 per annum. Graduate Scholarships : value £400 per annum. Student Scholarships : value £50–£200.

The closing date for the receipt of applications is the 1st May, 1959, for Student Scholarships, and the 1st June, 1959, for Graduate and Research Scholarships.

Full particulars of the conditions of award and nomination forms may be obtained on application to the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C.2. E5045 E

A.M.I.MECH.E., B.Sc., City and Guilds, &c. Guarantee Postal Courses for all Exams. and Technical Divisions from Elementary to Degree standard including Automation Techniques. Approximately 95 per cent. successes. 148-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E114 E

EDUCATIONAL

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

(UNIVERSITY OF LONDON)

POSTGRADUATE COURSE IN NUCLEAR POWER

A full-time postgraduate course in Nuclear Power is held each year at Imperial College. This course is conducted from the engineering point of view and is intended primarily for graduate engineers and applied scientists who wish to pursue a career in the design, development and construction of nuclear power stations. A special feature of the course is the inclusion of a design study of a complete nuclear power project. Experimental work will include the use of a natural uranium-graphite exponential assembly.

Further information may be obtained on application to the Registrar, Imperial College, London, S.W.7. E5186 E

COLLEGE OF AERONAUTICS

A COURSE OF LECTURES ON

AERODYNAMIC PRINCIPLES OF THE HELICOPTER

will be given at the College from Monday, 4th May, to Friday, 8th May, 1959.

The course will deal with the basic aerodynamics and performance of rotating wing aircraft, including discussions on problems of stability and control.

FEES for the course are :

Tuition Fee, £15 15s.

Residence Charge (including full board), £6 10s.

A copy of the syllabus and forms of enrolment may be obtained from The Warden, The College of Aeronautics, Cranfield, Bletchley, Bucks. E5221 E

COLLEGE OF AERONAUTICS

A COURSE OF LECTURES ON

PROBLEMS IN HYPERSONIC AERODYNAMICS

will be given at the College from Monday, 11th May, to Friday, 22nd May, 1959.

The course is intended for aerodynamicists, physicists and research workers who require a working knowledge of hypersonic aerodynamics. A knowledge of subsonic and supersonic aerodynamics and of mathematics up to Degree level is desirable.

FEES for the course are :

Tuition fee, 30 guineas.

Residence charge (including full board), 10 guineas.

Forms of enrolment and copies of the syllabus may be obtained from The Warden, The College of Aeronautics, Cranfield, Bletchley, Bucks. E5220 E

THE ROYAL COLLEGE OF SCIENCE AND TECHNOLOGY, GLASGOW

DEPARTMENT OF MECHANICAL, CIVIL AND CHEMICAL ENGINEERING

SESSION 1959–60

Postgraduate Course in

ENVIRONMENTAL CONTROL ENGINEERING AND RESOURCE UTILIZATION

Commencing MONDAY, 5th OCTOBER, 1959

The object of the course is to give qualified engineers an understanding of the numerous problems involved in large development projects. The subjects studied will include the control and utilisation of water resources ; transportation ; power resources ; agricultural, mineral and chemical resources ; social anthropology.

Prospective students should have an Engineering Degree or have other qualifications and experience, which will enable them to benefit from the course.

The course is approved by the Department of Scientific and Industrial Research for the award of Advanced Studentships. A limited number of College scholarships are also available.

Application forms and further information can be obtained from the Professor of Civil Engineering. E5223 E

THE ROYAL COLLEGE OF SCIENCE AND TECHNOLOGY GLASGOW

(In affiliation with the University of Glasgow)

RESEARCH SCHOLARSHIP IN CIVIL ENGINEERING

Applications are invited for a Research Scholarship in Civil Engineering, value £400 per annum, to carry out investigations into the Hydraulics of Water Treatment Plants. Applicants should have a good Honours Degree, but applications from those graduating this session will be considered. Every facility will be given for study towards a higher Degree.

The Scholarship will be of one year's duration, but subject to satisfactory progress may be extended to a maximum of three years to enable completion of higher Degree work.

Further details may be obtained from the Professor of Civil Engineering.

E5222 E

EDUCATIONAL

AUTOMATION.—AUTHORITATIVE COURSES are now available in Digital and Analogue Computer Technology, Applied Electronics, Data Processing and Instrumentation up to professional level by home study. Individual enrolment or industrial group scheme enrolments accepted. Syllabuses and prospectus sent on request.—Write (Dept. S.E.8), E.M.I. Institute School of Electronics, College House, Kensington, London, W.8. E145 E

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES, NOT ORIGINALS, OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.

A TECHNICAL SERVICE ENGINEER is required by Dresser (Great Britain), Ltd., Clark Bros. Co. Division. This Division is responsible to the United States Parent Company for the marketing of gas engines, motor-driven reciprocating compressors, centrifugal compressors and gas turbines, manufactured under licence in the United Kingdom and on the Continent. Candidates should be well qualified Graduate Mechanical Engineers, aged 28–35. The company is a well-established European organisation and offers good pay and conditions, with a pension scheme. There are excellent prospects for early advancement to full sales engineering responsibilities.—Apply, with full personal particulars and details of experience and previous appointments, to Dresser (Great Britain), Ltd., Clark Bros. Co. Division, 197, Knightsbridge, London, S.W.7. E2323 A

APPLICATIONS ARE INVITED FROM PROJECT ENGINEERS over 28 years of age and having H.N.C. minimum qualification, for a vacancy in the Production Engineering and Development Department at Ferodo, Limited. This is a senior staff appointment and candidates must have had experience in one or more of the following subjects :—Production engineering and plant layouts, factory mechanical services layouts, special plant design. The successful candidate will be responsible for handling projects through initial investigation, preparation of estimates and reports, ordering plant and equipment and arranging for installation and final handing over to the works.—Write, giving details of age, qualifications, previous experience and salary required, to the Personnel Manager, FERODO, LIMITED, Chapel-en-le-Frith, Via Stockport. E5208 A

ASSISTANT REQUIRED for small Engineering Department, age 21/23. Candidates must have some drawing-office experience, and those with O.N.C. in Mechanical Engineering and knowledge of hydraulics will be given preference.—Apply in writing, with full particulars, salary expected, to Secretary, E. P. BARRUS, LTD., 12–16, Brunel Road, W.3. E2334 A

ASSISTANT WORKS MANAGER

An opportunity awaits an ambitious and active engineer as Assistant Works Manager to a South African Engineering Company situated near Johannesburg. A graduate engineer is preferred, with works experience in the following fields :—

Foundry and Pattern Shop
Die and Free Forging
General Machine Shop
Steel Fabrication

A medical benefit and pension fund is in operation, both of which must be joined as a condition of employment.

Assistance in the transportation of the successful candidate and his family to South Africa would be given under a minimum four-year contract.

The commencing salary would be in the region of £1500 per annum, depending upon age and experience.

Apply in writing, with copies of references, to Arthur F. Parris, 34, Great St. Helens, London, E.C.3, by April 14th, 1959. E5243 A

DAVY AND UNITED ENGINEERING COMPANY, LIMITED

Britain's largest organisation of rolling mill and auxiliary plant manufacturers, invite applications from ambitious qualified men interested in heavy engineering, for positions as PROJECTS ENGINEERS. Successful applicants would have experience of steel and non-ferrous rolling mills of all types and will be responsible for engineering machinery prior to tendering. Items range from individual units to complete rolling mill plants.

All contracts, irrespective of size, have to be individually engineered, offering a wide range of interest and unlimited scope for ingenuity and initiative.

Excellent working conditions in modern building. Dining facilities, contributory pension scheme. Apply in writing, with details of age, experience, qualifications, &c., to : Personnel Department, Davy and United Engineering Co., Ltd., Darnall Works, Sheffield, 9. E5214 A

DRAUGHTSMAN REQUIRED for works engineer's department of large Coventry engineering company, for work in connection with industrial buildings and factory services. Some knowledge of heating and ventilation would be an advantage, but is not essential.—Reply, stating age, experience and salary expected, to Ref. JD1, BOX No. E5216, "The Engineer." A

ENGINEERING TRADE ASSOCIATION REQUIRES ASSISTANT to work at Ascot, Berks. Electrical engineering technical training essential. Preference given to man with practical experience transformers. Salary commensurate age, experience, qualifications. Pension scheme. Write, stating full particulars.—BOX No. E5234, "The Engineer." A

ENGINEERING EXPORTERS, LONDON, E.C. require TECHNICAL ASSISTANT to the Chief Estimator. Only those thoroughly competent in preparing tenders and quotations for machine tools and general industrial plant need apply. Some electrical experience is desirable but not essential. This is a post with good prospects for the right man. Fullest details, in confidence, of career to date, technical background, age and salary required.—BOX No. E5229, "The Engineer." A

Classified Advts. continued on page 132

BOOKS and PUBLICATIONS

HMSO

Noise in Three Groups of Flats with Different Floor Insulations

Describes the results of an investigation conducted in 1952-53 into the problem of sound insulation in dwellings. Illustrated with text figures.

4s. (*post 4d.*)

Roads in England and Wales, 1957-58

An illustrated account of a year of progress with the Government's road programme.

6s. (*post 5d.*)

From the Government Bookshops or through any bookseller

HMSO

THE HEAT TREATMENT OF STEEL
By Edwin Gregory, Ph.D., etc., and Eric N. Simons. New and up-to-date 2nd Edition. Covers every phase of the subject from principles to practice. It is very easy to read and explains what has to be done to different steels and why it is necessary. Recent developments are dealt with. 35s. net.

DIESEL PLANT OPERATORS' HANDBOOK
By A. K. L. McCrone, G.I.Mech.E. Here is a handy reference book that has been written specially for the operator of Diesel-Electric Power Plant. It gives in a concise and simplest possible form the essential facts about the equipment he uses. Theory and practice have been blended as far as possible. (Published on behalf of Blackstone and Co., Ltd.). 20s. net.

STRUCTURAL MECHANICS
By W. Morgan, B.Sc., etc., and D. T. Williams, A.M.I.Struct.E., etc. This new book commences at the beginning of the subject and treats its fundamental principles with the simplest mathematics. With problems included, it is suitable as a first course in Structures for all students of architecture, building, surveying and engineering. 30s. net.

THE SCIENTIFIC BACKGROUND
A Prose Anthology
By A. Norman Jeffares and M. Bryn Davies. It is a fact that during recent years there has been a deterioration in the ability to use language as a precise instrument. With a valuable introductory section and 100 carefully chosen extracts from the works of outstanding scientists, this book shows that good scientific prose is good English prose. 21s. net.

From all booksellers

PITMAN *TECHNICAL BOOKS*
Parker St., Kingsway, London, W.C.2

SITUATIONS VACANT

ENGINEERING TRADE ASSOCIATION REQUIRES ASSISTANT to work at Ascot, Berks. Electrical engineering technical training essential. Preference given to man with practical experience rectifier and power capacitors. Salary commensurate age, experience, qualifications. Pension scheme. Write, stating full particulars.—BOX No. E5235, "The Engineer." A

ENGINEERS
required by
MAJOR OIL COMPANY
for work on countrywide network of
MULTI-PRODUCT PIPELINES

(a) THREE QUALIFIED ENGINEERS, aged 30–38, to join a vigorous team responsible for the planning, design and control of the whole network. These positions are based in London but involve regular visiting of all areas. Car provided.

(b) TWO PIPELINE MOVEMENT PROGRAMMERS, aged 28–38, responsible for planning and co-ordinating all oil movements and analysing quality and statistical matters arising therefrom. Technical men required, preferably with H.N.C. or equivalent qualification. Work is mainly in London but some travel essential.

(c) TWO LINE AREA ENGINEERS, aged 35–40, for directly supervising all manpower, operations and equipment in their allocated area. Car provided. One to be based in South Yorks/North Notts district and the other in Kent/Surrey.

(d) TWO LINE AREA FOREMEN based as for Line Area Engineers above, to be responsible for direct supervision of operations, maintenance, &c., under the Line Area Engineer.

All these vacancies are for permanent, pensionable positions. Previous experience on pipeline work is not essential, but applicants must be keen and intelligent and willing to be trained to make their career in this field. Apply giving full details of age, qualifications and experience. —BOX No. E5204, "The Engineer." A

EXECUTIVE APPOINTMENTS, LIMITED

A leading manufacturer of electric motor control gear with 300 employees, a modern factory near London and resources for rapid expansion, seek a

SALES MANAGER

aged 35–45, educated to H.N.C. or Degree standard, with A.M.I.E.E. or equivalent qualifications and electrical engineering sales management experience ; and an

ASSISTANT WORKS MANAGER

aged 30–37, educated to A.M.I.Mech.E., A.M.I.E.E. or A.M.I.Prod.E. standard, with works management experience in light or electrical engineering.

Starting salaries about £2000 and £1500 respectively, with distinctly attractive prospects.

Write briefly, in strict confidence, knowing that identities will not be disclosed without permission.

The Managing Director (WB.26), EXECUTIVE APPOINTMENTS, LIMITED, 78, Wigmore Street, London, W.1.

E5209 A

EXPERIMENTAL DESIGN

An engineering design team is to be set up to work in association with a research group on the innovation of processes and plant for the steel industry. Its tasks will include the design of experimental plant and collaboration with leading plant manufacturers in piloting industrial developments arising therefrom.

Applications are invited for appointment as leading designer, with responsibility for the building up of the team. This is an opportunity for a man in his early thirties, with a degree in mechanical engineering or equivalent, works apprenticeship, and design experience, and a keen interest in translating novel ideas into workable designs, and to exercise his talents in the field of advanced development.

Starting salary up to £1500 ; F.S.S.U. scheme; Location of post, Sheffield.—Written applications only, quoting "M.W.D.1," to Personnel Officer, BRITISH IRON AND STEEL RESEARCH ASSOCIATION, 11, Park Lane, London, W.1.

E5203 A

GENERAL MANAGER of a British steel works invites applicants for the position of PERSONAL ASSISTANT. Applicants should possess a Science or Technical Degree and be prepared to handle *ad hoc* problems and assist in matters of administration. For the right type of individual the job, which is pensionable, is a progressive one. Please write, giving full particulars of age, qualifications and experience. —BOX No. E5190, "The Engineer." A

INSTRUMENT TECHNICAL SALES ENGINEERS.—Required for Manchester and Birmingham areas. QUALIFICATIONS—Should be at least to degree standard with emphasis on precision vacuum and pressure instrumentation. Knowledge of Control Instrumentation an advantage. Car provided and pension benefits will be offered to suitable applicants. Appointments will at first be at our Basingstoke Works for familiarisation of Company's products.—Apply : APPLEBY AND IRELAND, LTD., Basingstoke, Hampshire. E5237 A

LONDON TRANSPORT require a TEMPORARY ENGINEERING INSPECTOR, resident in the Manchester area, to undertake the inspection, at the place of manufacture, of maintenance supplies and equipment for new rolling stock for the Department of the Chief Mechanical Engineer (Railways). It is anticipated that the work will last for a minimum of four years. Applicants should have experience in the inspection of all classes of electric rolling stock equipment and the ability to draft clear and concise reports. Salary range £814–£906. Medical examination ; free travel.—Applications within 7 days to Staff and Welfare Officer (F/EV/727/3), London Transport, 55, Broadway, S.W.1. E5239 A

LEADING LOADING SHOVEL MANUFACTURER HAS VACANCY for a DESIGN DRAUGHTSMAN for the design and progressing of new developments in hydraulic loading shovels.

Applicants should have experience in medium general engineering fabrication and transmission design and should be able to work with a minimum of supervision.

H.N.C. minimum qualification.

Apply in writing to Chief Designer, F. E. WEATHERILL, LTD., Tewin Road, Welwyn Garden City, Herts. E2336 A

MACHINE SHOP FOREMAN required by large Engineering firm in South West Lancashire. Must be experienced with Capstan Lathes and Bar Automatics. Knowledge of thread rolling would be an advantage. Age limit 25–40 preferred. Excellent working conditions, Pension Scheme and Canteen Facilities. Applicants should apply in writing, stating age and experience.—BOX No. E5228, "The Engineer." A

MECHANICAL AND ELECTRICAL ENGINEER required by London consultants. Work covers layout of wide variety of industrial plants and design process services and mechanical handling. General engineering experience particularly as to application of services to plant operation essential but not specialisation such as workshop management and production. Post is as a senior engineer with good prospects and salary will be assessed in relation to experience. Vacancy is not a temporary one and within a reasonable age carries staff pensions.—BOX No. E5232, "The Engineer." A

MECHANICAL ENGINEERING DESIGNER for automatic production and assembling machines and mechanical handling of components. Varied projects require skill, enthusiasm. Salary about £1000.—Rhoden Partners, 29, Park Crescent, W.1. LAN 7488. E5238 A

METHODS AND COST REDUCTION ENGINEER
required by
NORTH BRITISH LOCOMOTIVE CO., LTD.
SPRINGBURN, GLASGOW

to study existing designs and methods of production and effect a reduction in costs in Departments handling Fabricated Structure, Piping Systems, Fitting and Erection Work.

The position is a well paid one and demands a high capacity for original thought together with a wide experience of manufacturing methods

Pension and Life Assurance Schemes, &c.

Apply to Engineering Director.

E5189 A

PRODUCTION AND DEVELOPMENT ENGINEERS

Qualified and Experienced ENGINEERS are required by a light engineering Company in the West of Scotland, who operate a policy of constantly improving quality and methods of manufacture. Each man should be capable of bringing to fruition engineering projects covering a wide field.

At least one Engineer having knowledge of press tool work is needed immediately. Starting salaries of £950–£1150 per annum are envisaged.

Brief details of qualification, experience and present salary.—BOX No. E5218, "The Engineer."

PUMPING ENGINEER. Technical sales and estimating with experience of public water supply and sewage contracts and knowledge of heating trade requirements. South London. £750–£1000 p.a.—BOX No. E2328, "The Engineer." A

QUALITY CONTROLLER.—Engineer, aged 30–40, required to institute a quality control system. This is a new appointment and a thorough knowledge of both theoretical and practical engineering is essential. The successful applicant should have experience in statistical and product quality control. —Applicants should reply to Personnel Manager, RUSTON-BUCYRUS LTD., Excavator Works, Lincoln, giving full details of education, training and salary required. E5242 A

ROBERT M. DOUGLAS (CONTRACTORS) LTD.,
require
QUANTITY SURVEYORS in the Midlands and South Wales for building and civil engineering works, including motorways and bridges. Must be contractor trained. Good prospects, pension scheme.—Apply in writing, stating age, qualifications and experience, to 395, George Road, Birmingham. E5153 A

SENIOR DESIGN DRAUGHTSMAN required by a large Midlands Steelworks. The position entails creative work in Heavy Engineering including rolling mills and preference will be given to candidates with experience in these fields. Excellent conditions, staff position, pension and free life assurance scheme. Apply, stating age, qualifications and details of experience and salary required to Chief Engineer.—BOX No. E5225, "The Engineer." A

SENIOR DESIGN DRAUGHTSMAN required for interesting work on mechanical engineering projects. Knowledge of hydraulics an advantage.—CHAMBERLAIN INDUSTRIES, LTD., Staffa Road, Leyton, E.10 (LEY 3678). E5094 A

SENIOR DRAUGHTSMEN required for interesting work on marine gearing. Applicants should preferably have served full apprenticeship and had several years' diesel or gearing drawing-office experience.—Apply, Technical Manager, MODERN WHEEL DRIVE, LTD., Lindo Lodge, Stanley Avenue, Chesham, Bucks. Tel. : Chesham 8000. E5180 A

SENIOR MECHANICAL ENGINEERING DRAUGHTSMAN required, H.N.C. standard and preferably with experience of plate bending and forming machines. Regular employment, pension scheme, &c.—Apply, giving full details, to Chief Engineer, Henry Berry and Co., Ltd., Croydon Works, Hunslet, Leeds, 10. E2330 A

TECHNICAL EDITOR required by rapidly expanding organisation in the East Midlands. This appointment carries an excellent starting salary and offers considerable scope for development to a man with ability, energy and a wide knowledge of production and mechanical engineering. Excellent superannuation scheme and pleasant surroundings. Send details of career and present salary.—BOX No. E5134, "The Engineer." A

TECHNICAL SALES REPRESENTATIVE
required for Home Counties area.

Applicants should be well-educated and accustomed to top-level contacts and must have a pneumatic engineering background, including some Workshop and/or Drawing-Office experience.

Salary according to age and experience. Car provided.

Write to :
The Manager,
HOLMAN BROTHERS, LTD.,
44, Brook Street,
London, W.1.

E5195 A

TECHNICAL SALES REPRESENTATIVE required for sale of high and low pressure pipework and steel fabrications up to 70 tons, to cover London and the Home Counties area. Must have sound engineering background and be capable of negotiating business at all levels. Only men of highest integrity and those able to work on own initiative will be considered. The position offers great scope to the right man. Car provided ; staff pension scheme. Send full details of age, past experience, qualifications and salary required, in own handwriting.—BOX No. E2335, "The Engineer." A

THE BRITISH STEEL PILING CO., LTD., require a CIVIL ENGINEERING ASSISTANT, aged about 25 to 30, for their London office. The work will involve the design of steel sheet pile retaining walls for all types of civil engineering structures, as well as cofferdams and bearing pile foundations. An Engineering Degree or equivalent qualifications are required. Previous experience of steel piling and soil mechanics is not essential, though desirable.—Apply in writing only, giving details of qualifications and experience, and stating age and salary required, to the Company at 10, Haymarket, S.W.1, marking the envelope "Civil Engineering Assistant." E5176 A

TRANSLATORS REQUIRED for translation of technical periodicals, books, &c., from and into Russian, German, French, Italian, &c. Sound knowledge of mechanical or production engineering essential. These are key positions in a rapidly expanding organisation in the East Midlands, with excellent prospects of advancement, working conditions and superannuation scheme.—Send full details to the Secretary, PRODUCTION ENGINEERING RESEARCH ASSOCIATION, Melton Mowbray, Leics. E5133 A

TECHNICAL LIBRARIAN

An Engineer is required to take charge of and develop a Technical Library.

The duties will include extracting information from technical publications and maintaining an appropriate cross index reference.

The essential academic qualification for this post is an H.N.C. in Electrical Engineering, or its equivalent. A knowledge of patent procedure and the ability to translate French and German would be an advantage.

A generous Staff Life Assurance and Pension Scheme in operation.

Apply in detail to the Personnel Manager,
THE RHEOSTATIC COMPANY, LIMITED,
SLOUGH, BUCKS.
E2337 A

JOSEPH LUCAS LIMITED

Manufacturers of Aircraft and Motor Equipment, require

FULLY EXPERIENCED
DESIGNERS

Preference will be given to applicants who are conversant with gas turbine combustion equipment or have experience of heat exchangers, ventilating practice, fans and oil firing equipment. Consideration will also be given to persons with good mechanical experience who could quickly adapt themselves to a wide range of products requiring initiative and drive. It is essential that applicants should hold the Higher National Certificate or possess similar qualifications. This is a well-paid position offering excellent chances of promotion. A generous Pension Scheme is in operation.

Apply NOW to the Personnel Manager, Hargher Clough Works, Burnley.
E5124 A

SHELL

THE SHELL PETROLEUM COMPANY LIMITED
requires for London Office
ENGINEERS

age 25–30 years with minimum qualifications of **G.I.Mech.E.** (an engineering degree and a knowledge of French would be an advantage).

(1) **AUTOMOBILE ENGINEER** for duties in connection with the lubrication of automotive equipment and involving contact with manufacturers and users of such equipment. Must have apprenticeship or practical training in general engineering plus subsequent experience in design or development and manufacture or servicing of gasoline engines, automotive chassis and transmissions.

(2) **MECHANICAL ENGINEER** for duties concerning the **LUBRICATION OF DIESEL ENGINES** and involving contact with manufacturers and users of this type of engine. Must have apprenticesnip or practical training in general engineering, plus subsequent experience in the design or development and manufacture or servicing of medium speed diesel engines (railway experience would be useful). Salary according to qualifications and experience. Five-day week and attractive pension benefits. Please write, giving full details of age, experience and qualifications to :

THE SHELL PETROLEUM COMPANY LIMITED,
STAFF DEPARTMENT R.L3,
ST. HELEN'S COURT,
GREAT ST. HELEN'S,
LONDON, E.C.3.
E5200 A

SIMON HANDLING ENGINEERS LIMITED
of the SIMON ENGINEERING GROUP

have vacancies for

ENGINEERS

Good prospects to men with University Degree or equivalent in Engineering and preferably with practical workshop, D.O. experience. Initiative and a strongly developed sense of responsibility are essential. Interesting work in the field of Pneumatic and General Materials Handling and Contracting Engineering.

Pension Scheme, 3 weeks holiday. Opportunity for travelling at home and abroad.

Application by letter giving full details in confidence to :

Personnel Director, Ref. SX89,
SIMON HANDLING ENGINEERS, LTD.,
Cheadle Heath, Stockport, Cheshire.
E5207 A

SITUATIONS VACANT

FACTORY ADMINISTRATION

A well-known Light Engineering Company, manufacturing high precision engine components in large quantities, is seeking the services of a

FACTORY MANAGER

to take charge of one of its plants, situated in the South Midlands, within easy reach of London.

Candidates should not be more than 45 years of age and should have, for preference, an Engineering background. Experience, in a Senior capacity, of general Factory Administration is, however, essential and only applicants who can give evidence of a good record of achievement in this field will be considered.

The position is permanent, a substantial salary is offered, and there is a sound pension and Life Assurance Scheme in operation.

Applications, which will be treated in the strictest confidence, should give details of education, experience and present position and responsibilities.—BOX No. E2331, "The Engineer."

A

SITUATIONS VACANT

CHIEF PROJECT ENGINEER

required by

ENGLISH ELECTRIC RUGBY

in its Plant and Buildings Department. Applicants should not be more than 35 years of age and be fully qualified Mechanical/Electrical Engineers. An extensive Plant background is essential, preferably in heavy industry, as the work will involve the supervision of staff responsible for the planning and execution of building or maintenance projects.

Please apply, giving details of experience to Dept. C.P.S., Marconi House, 336–7, Strand, London, W.C.2, quoting reference E1119B.

E5210 A

BUSINESSES & PREMISES

By Order of the Liquidator, R. Langdon Davis, Esq., F.C.A.

THE EXTENSIVE FREEHOLD FACTORY AND LAND

with Canal Dock frontage

SITUATE AT

SILVERDALE ROAD, HAYES, MIDDX.

SINGLE AND TWO STOREY SUBSTANTIAL BUILDINGS, ANCILLARY WORKSHOPS AND STORES, OFFICES, GARAGE, HOUSE, GOOD YARD SPACE AND LOADING. SPRINKLER AND CENTRAL HEATING INSTALLATIONS.

Main Floor Space about 70,500 sq. ft.
Ancillary Buildings about 11,500 sq. ft.
Ground area approximately 2½ Acres

to be submitted FOR SALE by AUCTION (unless sold previously), at The London Auction Mart, 155, Queen Victoria Street, E.C.4, on WEDNESDAY, the 22nd of APRIL, 1959, at 2.30 p.m.

BY THE JOINT AUCTIONEERS :

Messrs. **HENRY BUTCHER & CO.**, 73, Chancery Lane, W.C.2 (Tel.: HOLborn 8411), and Messrs. **MILLS AND WOOD**, 30, Fleet Street, E.C.4 (Tel.: Fleet Street 4754)

Solicitors, Messrs. George and George, 58, Victoria Street, S.W.1 (Tel.: Victoria 8093).

E5211 L

An Attractive Salary is offered by a well-known Company manufacturing Light Steel Pressings for the Motor Car and Allied Industries to a

MANAGER

who can take charge of and develop a new section of the business which has already reached the stage where it requires to be separated from the original work of a large Factory. The operations covered are

PRESSING AND FORMING

welding and various stages of Machining. At present, there is a mixed labour force of 50 or so. Precision standards are very high.

The person appointed will, ideally, be about 40/45 years of age with at least 20 years' experience of Press Shop work supported by knowledge of machining processes. He should have had several years' experience as a Manager or Senior Foreman.

Please write in confidence, giving details of age, qualifications, experience, &c., to BOX No. E2332, "The Engineer."

A

W. H. ALLEN SONS & COMPANY LIMITED, BEDFORD

CHIEF GEARING DESIGNER

required at the Company's recently-established and expanding Gearing Factory at Pershore, Worcs.

The Company is engaged in the manufacture of precision gearing, including gears of the epicyclic type, for industrial and marine applications.

A Qualified Engineer is required, aged between 30 and 40 years, with previous experience of Gearing Technology and Detailed Mechanical Design.

The salary for this permanent and pensionable position will depend solely on the qualifications and experience of the successful candidate.

Apply in confidence to :
The Manager, Gearing Department,
Atlas Works,
Pershore, Worcs.

E5201 A

COVENTRY

(Close City Centre and Main Line Rly. Stn.)

SINGLE STOREY FACTORY

71,000 sq. ft.

Freehold for Sale

Part north lighted. Central Heating.
Loading Bay. Good Yard Space.
Travelling Cranes in one Section.
12,000 ft. Cost of Works War Damage.
Payment outstanding. Particulars of :

HENRY BUTCHER & CO.,

73, Chancery Lane, W.C.2. Tel. : HOLborn 8411.

E5202 L

VICKERS-ARMSTRONGS (ENGINEERS) LTD.,

BARROW-IN-FURNESS

Applications are invited for posts as :

DRAUGHTSMEN & CHEMICAL ENGINEERS

Applicants should have completed National Service, preferably hold Higher National Certificate and had Drawing-Office experience in Chemical Plant. Preference will be given to those who are familiar with problems associated with Heat Transfer and Fluid Flow and have had experience in the fabrication and manufacture of associated equipment, the vacancies being at the Company's Barrow Works.

DRAUGHTSMEN *FOR GENERAL ENGINEERING & MARINE WORK*

Applicants should have completed National Service and preferably hold Higher National Certificate. Preference will be given to those who have had experience in General Arrangement Drawings associated with Marine Propulsion Work, the vacancies being at the Company's Lancaster Drawing-Office.

A Life Assurance and Pension Scheme is in operation and applications, giving full details of age, experience and qualifications, should be made in writing to :

The Technical Manager,
VICKERS-ARMSTRONGS (ENGINEERS) LTD.,
Naval Construction Works, Barrow-in-Furness, Lancashire.

E5182 A

SOUTH AFRICA

Owner of private Engineering Company wishes to sell well-equipped concern in a large City in Southern Africa.

The Company is in a satisfactory financial position and is a rare opportunity for a British concern to acquire a ready-made and established business in Africa.

Full details upon application with Bankers' and Auditors' Reports to Principals only.—BOX No. E5155, "The Engineer."

L

ENGLISH ELECTRIC

A number of vacancies have arisen for engineers to work on the

DEVELOPMENT OF PRODUCTION PROCESSES

in relation to the manufacture of Steam Turbines, Gas Turbines, Water Turbines, Diesel Engines, Nuclear Reactors.

Applicants should be qualified to at least H.N.C. Standard, and should have considerable experience of the design and development of machine tools or mechanical handling equipment. Vacancies exist at both the Rugby and Whetstone works of the Company.

Please write giving details of qualifications and experience to Dept C.P.S., Marconi House, 336–7, Strand, London, W.C.2, quoting reference E 1995E.

E5206 A

SITUATIONS WANTED

ENGINEER (36) seeks responsible position with London Company. Works apprenticeship, Project Design. Estimating, Administration experience for Mechanical and Chemical Projects. Handle Staff.—BOX No. E2327, "The Engineer." B

ENGINEER with 38 years' Boiler and Power House Sales and Construction experience, seeks to Represent a reputable Engineering Company on the South Coast. Salary secondary consideration.—BOX No. E2324, "The Engineer." B

PATENTS

THE PROPRIETOR of British Patent No. 723,197, entitled "STONE-CUTTING CABLE SAW," offers same for license or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern and Carlberg, 14, E. Jackson Boulevard, Chicago 4, Illinois, U.S.A. E5181 H

THE PROPRIETOR OF BRITISH PATENT 794,166, for "Improvement in or relating to the Reinforcement of Fibreglass Boat Hulls or Other Bodies of like Flexible Nature Made from a Plastic Material," desires to enter into negotiations with a firm or firms for the Sale of the Patent or for the grant of Licences thereunder.—BOX No. E2329, "The Engineer." H

BUSINESS OPPORTUNITIES

COULD YOU TURN INTO A TYCOON? Then enter the News Chronicle "Get Ahead" Competition right away. There's £5000 for a man or woman with a bright business idea. See B.B.C. T.V. on Tuesday. E5199 O

FOR HIRE

LATTICE STEEL. Erection Masts (light and heavy), 30ft. to 150ft. high, for immediate hire.—Bellman's, 21, Hobart House, Grosvenor Place, S.W.1. ('Phone, SLOane 5259). E103 K

SUB-CONTRACTING

CASTINGS.—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process ; sample castings treated ; A.I.D. approved.—Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex ('Phone Byron 1178). E109 MW

KELLERING AND CAM PROFILING capacity up to 8ft. by 6ft. or 6ft. diameter.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Telephone : Knottingley 2743/4). E116 MW

AGENCIES

ENGINEER AGENTS REQUIRED

Small Group of Companies whose expanding activities include manufacture and installation of purpose-made mechanical handling equipment, dust extraction and oil-fired air heating installations, seek the services of established AGENTS in the Lancashire, Midlands and London areas.

In the first instance reply, giving details of existing commitments, location and facilities available.

BOX No. E2338, "The Engineer." D

MACHINERY Etc. WANTED

7IN. CENTRE LATHE to admit 7ft. max. between centres, motorised 400/440/3/50 cycles supply.—BOX No. E5231, "The Engineer." F

MACHINERY WANTED

ALL-ELECTRIC EXCAVATOR, about 3 cu. yd. capacity, in reasonable condition, old model would suit.—BOX No. E2333, "The Engineer." F

Classified Advts. continued on page 134

MACHINERY Etc. WANTED

BLACKBURN & DISTRICT HOSPITAL MANAGEMENT COMMITTEE

WANTED

Second-hand TURBINE-DRIVEN HOT WATER CIRCULATING PUMPS. Turbine single-stage ; steam pressure, 100 p.s.i., exhaust pressure, 5 p.s.i. ; governor controlled. PUMP, Worthington, or similar, 6in. suction, 5in. delivery, capable of 400 galls./min. Driven through vee belts or flexible coupling, all mounted on bed plate.

Prices and permission to view to the Superintendent Engineer, Queens Park Hospital, Haslingden Road, Blackburn, Lancs.

E5177 F

FOR SALE

TWW

HYDRAULIC PRESSES

500-ton FIELDING and PLATT, 4-COLUMN, DOWNSTROKE, 24in. stroke, ram 12in. dia., Fraser OLS 30 hydraulic pump, 3200 p.s.i. working pressure.

200-ton FAWCETT PRESTON 4-COLUMN DOWNSTROKE, ram 20in. dia., stroke 24in., 26½in. between columns.

190-ton SHAW 4-COLUMN UPSTROKE PLUNGER PRESS, main ram 19in. dia. by 17in. stroke, downstroke plunger ram 8in. dia., 36in. between columns.

100-ton FIELDING and PLATT, 4-COLUMN DOWNSTROKE, ram 9in. dia., stroke 4ft., Fraser type OLS 30 pump, 3200 p.s.i. working pressure.

THOS. W. WARD LTD.

ALBION WORKS - - - SHEFFIELD.
'Phone : 26311. 'Grams : " Forward."

E215 G

600

COMPRESSOR SETS

2500 c.f.m. BELLISS and MORCOM 100 p.s.i., with 550 h.p. Crompton Parkinson motor, 3·3kV or 400/440/3/50.

1550 c.f.m. BELLISS and MORCOM, 100 p.s.i., with 328 h.p. slipring motor, 400/3/50.

410 c.f.m., 120 p.s.i., BROWETT LINDLEY, with Laurence Scott and Electromotors, 95 h.p. slipring motor, 400/3/50.

TWO 330 c.f.m. BROOM and WADE 100 p.s.i., with Brook 75 h.p. slipring motor, 400/3/50.

Many others in stock would welcome your inquiries.

GEORGE COHEN,

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WOOD LANE, LONDON, W.12.
Tel.: Shepherds Bush 2070 ; and
STANNINGLEY, Nr. LEEDS.
Tel.: Pudsey 2241.

E203 G

FOR SALE

ONE 30ft. by 9ft. Lancashire Boiler by Adamson in 1939, suitable for steaming at 220 p.s.i., complete with Danks Chaingrate Stoker (new 1955) and all ancillary gear (new 1955).

ONE Economic Boiler by Danks in 1941, suitable for steaming at 120 p.s.i., complete with Bennis Stoker, feed pump, forced and induced draught fans with motors, &c.

ONE Water Softening Plant (Hot-type, Lime Soda) by Permutit, 1954, to handle 5500 g.p.h.

ONE Greens Economiser No. G.7213, 240 tubes, with 2 h.p./440 volt motor and all gear.

ONE Induced Draught Fan, complete with V-rope drive and 45 h.p. T.E.F.C. Motor by B.T.H. for 440 volt.

ONE Forced Draught Fan complete with V-rope drive and 25 h.p. T.E.F.C. Crompton Parkinson motor and starter for 440 volt.

ONE Weir Boiler Feed Pump 7in. by 9½in. by 21in. stroke.

ONE Weir Boiler Feed Pump 8in. by 10½in. by 22in. stroke.

ONE Kent type KM/CD Steam Meter, 0–50,000 lb. per hour.

ONE Kent 2-pin Temperature Recorder 200 deg.–1000 deg. Fah.

ONE Cambridge 2-pin Temperature Recorder *50.

ONE Budenberg Pressure Recorder, 8in. chart, 0–120 p.s.i.

FOUR sets BENNIS Stoker Gear for 30ft. by 9ft. Lancashire Boilers.

ONE Radiovisor Smoke Density Indicator for 200/250 volt supply.

All enquiries to Buying Dept.,

BROTHERTON AND COMPANY, LTD.,
P.O. Box No. 6, Leeds, 1.
Tele. : 29321.

E5165 G

NISSEN TYPE HUTS for sale. Prompt despatch of 16ft., 24ft. and 30ft. wide huts ; also " Romney " Huts, 35ft. wide, and " Blister " Hangars, 86ft. 6in. and 91ft. wide. These buildings are in various lengths and comprise steel framework with galvanised corrugated steel sheeting.—Full details from Dept. 115, J. Thorn and Sons, Ltd., Brampton Road, Bexleyheath, Kent (Tel. : Bexleyheath 305).

E113 G

TWO BROOM AND WADE 4-CYL. STATIONARY AIR COMPRESSORS, each 600 c.f.m., 100 lb. working pressure, 120 h.p. motors and starters for 400/3/50 supply. £495 each, loaded to transport—for prompt disposal only.—BOX No. E5212, " The Engineer." G

FOR SALE

FRED WATKINS (ENGINEERING), LTD.

STEAM BOILERS.—Cochrane Vertical (New), 8ft. 6in., 8ft., 7ft. 6in., 7ft. and 6ft. in dia., 100/150 lb. w.p. ; reconditioned 8ft. 6in. down to 3ft. dia. ; Economic 4ft. to 11ft. 6in. dia., including new 7ft. and 8ft. dia., 150, 180 and 200 lb. w.p. ; 300 reconditioned Vertical Crosstube, all sizes.

AIR COMPRESSORS.—Two Belliss & Morcom 2500 c.f.m., 100 p.s.i., 550 h.p. motors ; also Broomwade 500, 400, 300, 200 and 130 c.f.m., all motorised ; and several others of various makes and capacities.

200 AIR RECEIVERS, stocked up to 9ft. dia., 100 to 500 lb. pressure.

ELECTRIC MOTORS.—150 Totally Enclosed and Flameproof Motors up to 100 h.p.

MOBILE ROAD CRANES.—10-ton Lorain lorry mounted, 30ft.–70ft. extendible jib ; 10-ton 33 R.B. track mounted 40ft. jib ; 8½-ton Ransomes Petrol/Electric, 21ft. jib ; 6-ton Coles Diesel/Electric, pneumatics, new 1948 (2) ; 6-ton Coles Diesel/Electric, solids ; 4-ton Coles Diesel/Electric, solids, 1945 ; 4-ton Jones KL44, diesel, 1950 ; 3-ton Jones " Super 40 " diesel, pneumatics (3) ; 2-ton Jones " Super 20 " diesel, pneumatics.

DERRICK CRANES.—10-ton Anderson Grice steam, 120ft. jib ; 7-ton Rushworth hand, 30ft. jib ; 5-ton Wilson Electric, 70ft. jib ; 1½-ton Anderson Grice, hand, 40ft. jib.

RAIL CRANES.—18-ton Brownhoist, steam, 50ft. jib ; 10-ton Coles steam, 40ft. jib ; 8-ton Wilson steam, 35ft. jib ; 5-ton Smith, 50ft. jib (2) ; 5-ton Cowans Sheldon, 50ft. jib.

LOCOS.—Fowler diesel, 150 h.p. (2) ; Ruston diesel, 80/88 h.p., new 1942 ; Bagnall 14in. by 22in., two oil fired, one coal,; Peckett steam, 7in. by 12in., 1941 ; also 3 miles track, 24in. gauge, Bogies, Turnouts, &c.

STEEL PIPING.—50,000ft., 2in. Galvanised, new ; 60,000ft., 3in. black, new ; 5000ft. 8in. seamless ; 1000ft., 12in. seamless ; 500ft., 14in. seamless ; 400ft., 18in. riveted ; 280ft., 21in. o.d. welded flanged ; 3800ft., 21in. seamless flanged ; 500ft., 24in. riveted ; 1450ft., 27in. o.d. welded flanged ; 216ft., 48in. riveted ; 216ft., 60in. riveted.

CAST IRON PIPES.—Large stocks all sizes up to 24in. flanged and s.s. Immediate delivery.

VALVES.—Exceptional Surplus Ministry Lot New Stainless Acid Cocks and Valves, over 5000, immediate delivery, below makers' prices. Large stock all sizes, Parallel Slide Sluices, Gunmetal, Reducing and Check Valves. List on request.

STORAGE TANKS.—300 cylindrical and rectangular up to 12,000 gallons, for oil and petrol, also sectional steel and cast iron up to 50,000 gallons.

MACHINE TOOLS.—Scriven Plate Bending Rolls, 14ft. by ¼in. ; Robertson Straightening Rolls, 8ft. 6in. by ¼in. ; Berry Bending Rolls, 7ft. by ¼in. ; Tangye 200-ton Hydraulic Vertical Straightening Press, 15ft. by 3ft. table ; Herbert 3ND Miller, 61in. by 15in. table ; Pels Punch and Shears, ¾in. capacity ; nine new 2 cwt. and 1 cwt. Pneumatic Hammers ; Bliss 14T Tapering Press ; Bonn Hydraulic Tube Bender up to 20ft. by 4in. bore ; Bigwood geared Bending and Straightening Machine up to 12in. by 6in. R.S. Joists ; two 40kVA Spot Welding Machines ; Wire Drawing Machine, 3 die up to ¾in. copper ; 50kW Electric Furnace 1000 deg. Cent., chamber 54in. by 30in. by 21in.

SLING ENGINEERING WORKS
COLEFORD, GLOS.
'Phone : Coleford 2271/2. E106 G

600

FOUR skid-mounted, 132kVA. ROLLS-ROYCE 380/400 volts, 3-phase, 50-cycles, self-contained DIESEL - ENGINE - DRIVEN ALTERNATOR SETS, housed in sheet steel enclosure. Engine is radiator fan cooled and arranged for electric starting, and is direct coupled at 1500 r.p.m. to alternator by MACFARLANE. Each complete with switchboard.

GEORGE COHEN,

SONS AND CO. LTD.
WOOD LANE, LONDON, W.12.
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E204 G

FOR SALE

10-ton Morris 3-motor, Cab controlled Overhead Electric Travelling Crane, 45ft. span, Electrics 460/500V. d.c.

7½-ton Aabacas Ditto, 31ft. span, 400/3/50, new 1953.

5-ton Heywood Ditto, 36ft. 3in. span, 400/3/50, new 1950.

5-ton Anderson-Grice Ditto, 36ft. 3in. span, 400/3/50, new 1950.

5-ton Royce Ditto, 54ft. 3in. span, 220V, d.c., new 1936.

10-ton Morris Ditto, 62ft. 6in. span, Hand, new 1936.

F. BURRILL AND CO.,
235a, Cathedral Road, Cardiff.
Tel. : 26100. E5168 G

FOR SALE, HEAVY STEEL OVERHEAD TRAVELLING CRANE GANTRY, capable of carrying two 130-ton overhead travellers ; 182ft. long, height to crane rails 30ft., box section longitudinal girders 3ft. deep, 16 stanchions of lattice box construction. Total weight 150 tons. With or without two 130-ton Electric Hydraulic Overhead Travelling Cranes, 37ft. span.

REED BROTHERS (ENGINEERING), LTD.,
Replant Works,
Woolwich Industrial Estate,
London, S.E.18.
Telephone : Woolwich 7611/6.

E5139 G

SAMUEL PLATT MOTORISED DRAW BENCH for sale. Approximately 20ft. draw. Chain links 7½in. by 2in. by ¾in. thick. Solid spacer 1¼in. thick. Diameter of chain pins ¾in. Electrical equipment suitable for 400/3/50. Worm gear reduction unit. Weight about 5 tons.—F. J. Edwards Limited, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham, 3. E5246 G

FOR SALE

SERVICE EDWARDS VALUE!

BESCO No. 21 size Inclinable Power Press, Treadle-operated non-repeat clutch, ram fitted with knock-out, fitted with detachable tie bars, standard stroke 3in., centre to back 9½in., bed 27in. by 18in., hole in bed 11½in. by 12in., can be supplied for belt drive or self-contained motor drive.

ROBERTSON Motorised Geared Section Rolling Machine, at present fitted with rollers for forming 2½in. by 2½in. angle sections, diameter of roll shafts 2½in., width between bearings 16½in., working centres adjustable up to 7½in., 14 rollers arranged in 7 pairs, arranged motor drive for 400/440/3/50.

NEW STOELTING Pyramid Type Plate Bending Roller, motorised 400/440/3/50, capacity 10ft. wide by ¾in. mild steel, diameter of rollers, top 9½in., bottom 7¾in., drop end bearing for removal of completed cylinders, support rollers to bottom rolls, Reduction Gearbox drive to bottom rolls with multi-disc slipping clutches, motorised adjustment to top roller.

RUSHWORTH Double-Geared Open-Ended Power Guillotine, Overcrank type, fitted with automatic sheet hold-down and adjustable front, back and side gauges, arranged motor drive for 380/440/3/50, capacity mild steel 4ft. by ¼in., gap in open ends 6½in.

NEW BESCO 8ft. 4in. by ⅜in. Type HK, All Steel Undercrank Open-Ended Production Power Guillotine of all steel construction, arranged motor drive for 400/440/3/50, length of blades 110½in., capacity ⅜in., gap in side frames 3½in., strokes per minute 54.

CRAIG & DONALD Model 400/10, All Steel Motorised Double Geared Press Brake of steel plate construction, arranged motor drive for 440/3/50, pressure exerted 400 tons, former capacity 10ft. by ¾in., depth of gap 12in., width between side frames 82in., stroke approximately 4in., weight approximately 29 tons.

Photographs of the above are available.

Very favourable Hire Purchase terms can be obtained.

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Of Every Description. Attractive Prices.

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Telephone : EUSton 4681–3771,
and at
LANSDOWNE HOUSE, 41, WATER STREET,
BIRMINGHAM, 3.
Telephone : Central 7606–8. E207 G

HYDRAULIC PRESSES

3000-ton PLATE FORMING AND BENDING PRESS, table 16ft. by 4ft. 6in., admits 10ft. 6in. between columns.

2000-ton HYDRAULIC FORGING PRESS, admits 8ft. 6in. between columns.

1000-ton HYDRAULIC FORGING PRESS by Wellman, admits 6ft. between columns.

LARGE STOCK OF HYDRAULIC PRESSES OF ALL TYPES.

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REPLANT WORKS,
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FOR SALE

NEW MITCHELL 16½IN. CENTRE BY 24FT. GAP BED LATHE

admits 17ft. 3in. between centres ; swing 61in. by 18½in. in gap ; 4¼in. hollow spindle.
Immediate delivery.

F. J. EDWARDS LTD.,
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E5188 G

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CHAINS of every type—small or large—Brass, Steel or Aluminium. Hooks, Rings and Wire-forms.

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CHAIN HOUSE,
WOODBRIDGE STREET, LONDON, E.C.1.
CLErkenwell 3742/3.

E5049 G

NEW OVERHEAD CRANES

60-ton Goliath, by Clyde, 40ft. span, 5-ton auxiliary, cab control, 400/3/50.

40-ton Goliath, by Babcock and Wilcox, 40ft. span, 5-ton auxiliary ; cab control, 400/3/50.

30-ton Adamson, 42ft. 3in. span, 5-ton aux.; new in cases.

20-ton Vaughan, 42ft. 3in. span, 6-ton aux., 17ft. lift, six available.

20-ton King, 42ft. 3in. span, unused.

10-ton Goliath, by Morris, 40ft. span, cab control, 22ft. lift, 400/3/50.

Surplus Unused Ministry Cranes, mainly still packed. Drawings on request. Inspection invited. Bargain prices.

FRED WATKINS (ENGINEERING),
LTD., COLEFORD, GLOS.
Tel.: Coleford 2271/2/3.

E132 G

FOR SALE

600

FOUR 400 h.p. ROLLING MILL DRIVES by English Electric Co., for 440 volts, 3 phase, 50 cycles supply, each comprising slipring motor, 738 r.p.m., coupled to gearbox giving final 30 r.p.m., with barring motor, control gear, oil pumps, oil cooler, transformer available for 11,000/415 volts with switchgear.

2500kW., 440 volts, 3 phase, 50 cycles pass-out condensing STEAM TURBO-ALTERNATOR SET by British Thomson-Houston, 255 p.s.i. initially, capable of extracting 55,000 lb. or more steam/hour at pressures up to 35 lb., turbine also designed to operate fully condensing and is complete with ancillaries and switchgear.

TWO 1000kW., 3·3kV., 3 phase, 50 cycles back pressure type STEAM TURBO-ALTERNATOR SETS incorporating turbines by Belliss and Morcom, speed 4500 r.p.m., steam pressure 195 p.s.i., 380 deg. F. temperature, exhausting against 15 lb. back pressure, direct coupled through David Brown gearbox ratio 4·5 : 1 to alternator by Harland Engineering Co., with direct coupled exciter, each complete set mounted on cast iron baseplate and complete with switchgear with automatic voltage regulator, also hand operated overhead crane.

700kW., 875kVA., 6·6kV., 3 phase, 50 cycles pass-out/condensing STEAM TURBO ALTERNATOR SET, comprising multi-stage turbine by Fraser and Chalmers, designed to work with steam at 180 p.s.i. initially, 420 deg. F. temperature and to pass out up to 10,000 lb. steam per hour at 30 lb. pressure, turbine complete with standard ancillaries and surface condenser and direct coupled through gearbox to alternator by General Electric Co., complete with switchgear.

TWO 450kW., 6·6kV., 3 phase, 50 cycles 4-wire DIESEL ENGINE DRIVEN ALTERNATOR SETS, direct coupled at 375 r.p.m., incorporating vertical, 6-cylinder Belliss and Morcom diesel engine, direct coupled to alternator by Metropolitan Vickers, each set complete with standard ancillaries, starting equipment and switchgear.

TWO 300kW., 375kVA., Peter Brotherhood/General Electric Co. 400 volts, 3 phase, 50 cycles, 4-wire DIESEL ENGINE DRIVEN ALTERNATOR SETS, each mounted on baseplate and direct coupled at 750 r.p.m., each complete with standard ancillaries, starting equipment and switchgear.

GEORGE COHEN,

SONS AND CO. LTD.
WOOD LANE, LONDON, W.12.
Tel.: Shepherds Bush 2070.

E200 G

SECTION ROLLER BY ROBERTSON

FOR SALE

At present set up with 7 pairs of rollers for forming angle sections 2½in. by 2½in. Roll shafts 2½in. dia., centres adjustable up to 7½in. Weight about 6 tons. Photo.

F. J. EDWARDS LTD.,
359, EUSTON ROAD,
LONDON, N.W.1.

E5245 G

FOR SALE

RAILWAY TURNTABLE
For sale.—Mundt type standard gauge turntable, 65ft. long, carrying capacity 150 tons approx.

WATER CRANE
3000 gallon water crane.

TURNOUTS
Twenty 1 in 8 turnouts in 75 lb. F.B. rail ; interchangeable to suit L.H. or R.H.

All these items are in excellent condition.

Apply : EAGRE CONSTRUCTION CO., LTD., East Common Lane, Scunthorpe, Lincs. ('Phone : 4513.) E150 G

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NEALS 1-ton " D " MOBILE, 30ft. swan-neck, Ruston engine, pneumatics. £750.
RUSHWORTH 2-ton Hand DERRICK, 50ft. jib, A.S.L.I. £350.
NEALS 2-ton NM MOBILE, 30ft. jib, crawlers, Ruston engine. £1400.
JONES " Super 20 " MOBILE, 24ft. jib, Lister diesel, solids. £400.
JONES " Super 22 " MOBILE, 16ft. cantilever, pneumatics. £950.
NEALS " NM " 3-ton MOBILE, 30ft. lattice, Ruston engine, pneumatics. £2950.
ANDERSON-GRICE 3-ton Electric DERRICK, 120ft. jib, S.L.I. £1600.
JONES KL44 4-ton MOBILE, 40ft. jib, Ruston diesel, pneumatics. December, 1955. £3300.
WILSON 5-ton STEAM LOCOMOTIVE, 50ft. lattice, 4ft. 8½in. gauge. £1700.
COLES THORNEYCROFT 5-ton LORRY MOUNTED, Mk. 7 series 7, 40ft. jib, rope-derricking. £2800.
NEALS 4/6-ton QM MOBILE, 26ft. jib, Ruston engine, pneumatics. £2675.
COLES S.88, 6-ton MOBILE, 21ft. 9in. cantilever, solids, Perkins engine. £2250.
COLES 6-ton LORRY MOUNTED, rope-derricking, 17/35ft. jib. £3300.
BUTTERS 7-ton, 2-motor ELECTRIC DERRICK, 120ft. jib. £2975.
MICHIGAN TMCT 16, 7¼-ton LORRY MOUNTED, crowd shovel, dragline and 30ft. jib, Buda diesel, pneumatics. £3650.
HENDERSON 10-ton Steam DERRICK, 120ft. jib, bogies available.
SMITH 10-ton STEAM LOCOMOTIVE, 40ft. jib, 4ft. 8½in. gauge. £3500.
ANDERSON-GRICE 10-ton Single-motor ELECTRIC DERRICK, 120ft. jib. £4150.
COLES 10-ton Fully MOBILE, 40ft. jib, Perkins engine, pneumatics. £5350.
COLES 12½-ton Fully MOBILE, 80ft. jib. £4950.

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FOR SALE.—One 4-ton RAIL TELPHER with 475 yards of track, Telpher House, one 30 cwt. (nett) Grab and one 3-ton (nett) Skip. Height of track from ground is 40ft.—Further information may be obtained from the Works Engineer and Manager, SOUTH WESTERN GAS BOARD, Canons' Marsh Gasworks, Bristol, 1. E5244 G

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Two RUSTON & HORNSBY " Thermax " (wet back) treble pass, 10ft. 6in. dia. by 13ft. 6in. long excluding smokebox and flue outlet, 13,000 lb. per hour, 200 p.s.i.
Three FOSTER YATES & THOM double pass, 9ft. 9in. by 15ft. 6in. by 20ft. 6in., 12,000 lb per hour, 160 p.s.i.
Two JOHN THOMPSON treble pass, 9ft. 6in. by 14ft. by 19ft., 9500 lb per hour, 120 p.s.i.

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E R

By Order of the Minister of Supply

GOVERNMENT SURPLUS STORES

SALES BY AUCTION

		Main Location	*Auctioneers*
March 25–26	**Machine tools and miscellaneous stores,** including gravity conveyor rollers, etc.	Technical Stores Depot, **Old Dalby, Leics.** (Sale at Melton Mowbray.)	**SHOULER & SON** (Dept. L), 1, Norman Street, Melton Mowbray, Leics. (Tel.: 3081.)
April 6–10	**Vehicles, lifting and earth moving equipment, etc.,** including:	M.O.S. Storage Depot, **Ruddington, Notts.**	**WALKER, WALTON & HANSON** (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 54272.)
	230 saloons and estate cars, including Citroen " DS 19," 150 Morris " Minors," Ford " Anglias " and " Populars," 330 Jeeps and Land Rovers, utilities, trucks, vans and tippers, coaches, tankers (many fitted diesel engines), 22 White scout cars, trailers 10 cwt. to 15 tons, fitted mobile workshops, excavators, including LIMA " 1201 " crane rigged, Koehring, Ransomes & Rapier and Wayne, mobile cranes by Coles, Hyster, Jones, Lorain and Ransomes & Rapier, tractors, bulldozers and angledozers, including 110 by Caterpillar and International, road rollers, rooters, fork lift trucks, plant spares, wheels and tyres, batteries, truck cabs, bodies and petrol tanks, 730 motor cycles, including 160 Triumph " Twins," others by B.S.A., Matchless, Norton, etc.		
April 8	**Miscellaneous stores,** including textiles, furniture, etc.	Command Ordnance Depot, **Hilsea, Portsmouth, Hants.**	**HALL, PAIN & FOSTER** (Dept. L), 54–60, Commercial Road, Portsmouth. (Tel.: 24421.)
April 14	**Vehicles, motor cycles, M.T. Spares, miscellaneous stores,** etc.	Central Ordnance Depot, **Bicester, Oxon.**	**MIDLAND MARTS, LTD.** (Dept. L), Market Square, Bicester, Oxon. (Tel.: 73.)
April 21–22	**Miscellaneous stores.**	M.O.S. Storage Depot, **Byley, Nr. Middlewich, Cheshire.** (Sale at New Islington Public Hall, Ancoats, Manchester.)	**J. H. NORRIS & SON** (Dept. L), 9, Albert Square, Manchester, 2. (Tel.: Blackfriars 8373.)
April 28–30	**Machine tools and miscellaneous stores.**	M.O.S. Storage Depot, **Royal Arsenal, Woolwich, S.E.18**	**FULLER, HORSEY, SONS & CASSELL** (Dept. L), 10, Lloyd's Avenue, E.C.3. (Tel.: Royal 4861.)

Applications for catalogues should be made *only* to the auctioneers shown above (price of catalogue 1s. 0d., P.O. only).

SALE OF BOOTS BY TENDER

The Minister of Supply announces the disposal of approximately 658,000 pairs of ARMY ANKLE BOOTS. These will be sold by tender FOR EXPORT ONLY in lots of approximately 10,000 pairs.

The sizes range from 2 to 13, with the bulk lying in the size ranges 7 to 9.

Applications for forms of tender should be sent to the Ministry of Supply, Director of Disposals D. 4 (c), Room 615, First Avenue House, High Holborn, London, W.C.1. Full conditions of contract, including undertaking to export, are contained in the document.
Completed tenders to be submitted by 20th April, 1959.

E118 J

FOR SALE

CD

Second-hand Relayable F.B. Rails, 75 lb. per yard, 36ft. lengths ; 35 lb. per yard, 30ft. lengths ; 20 lb. per yard, 12ft. lengths. Unused quality from £22 per ton delivered.

COX AND DANKS, LTD.,
WADSLEY BRIDGE,
SHEFFIELD, 6.
Telephone : 344391.

E5192 G

ONE ALLEY AND MACLELLAN 1600 C.F.M., 2-CYL. VERTICAL AIR COMPRESSOR, less motor, water cooled. Size 12D, Series 18B.—BOX No. E5213, " The Engineer." G

FOR SALE

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INDEX TO ADVERTISERS

PAGE

Abbot Engineering Co., Ltd.... 79
Abingdon King Dick, Ltd..... 90
Accurate Recording Instrument Co..... 34
Aero Maintenance Equipment, Ltd..... 75
Air Control Installations, Ltd. 95
Airscrew Co. & Jicwood, Ltd....138
Allday, W., & Co., Ltd..... 6
Allen, W. G., & Sons (Tipton), Ltd..... 81
Allott Bros. & Leigh, Ltd.....125
Allspeeds, Ltd..... 11
Aluminium Wire & Cable Co., Ltd.....102
Ames Crosta Mills & Co., Ltd. 52
Anderton Springs, Ltd..... 92
Armstrong Siddeley Motors 4–118
Armstrong Stevens & Son, Ltd..... 68
Ashton, N. C., Ltd.....125
Ashworth Ross & Co., Ltd.....35
Atcost, Ltd..... 13
Austin, J., & Sons (Dewsbury), Ltd..... 5
Autometric Pumps, Ltd..... 55
Avery, W. & T., Ltd..... 82

BX Plastics, Ltd..... 59
Babcock & Wilcox, Ltd..... 9
Baker, P. W., & Sons (Sales), Ltd..... 21
Barr Thomson & Co., Ltd..... 26
Belmos Co., Ltd.....108
Birfield Industries, Ltd..... 61
Birkett, T. M., Billington & Newton, Ltd.....101
Birmingham & Blackburn Construction Co., Ltd.....115
Blackstone & Co., Ltd..... 75
Blakeborough, J., & Sons, Ltd. 76
Boilerine, Ltd.....116
Booth, J., & Bros.....100
Boulton, W., Ltd..... 51
Braby, F., & Co., Ltd..... 99
Bray, G., & Co., Ltd..... 33
Brett's Patent Lifter Co., Ltd.... 48
British Ermeto Corporation, Ltd.....111
British Federal Welder & Machine Co., Ltd..... 57
British Industrial Engineering Co. (Staffs), Ltd..... 41

PAGE

British Insulated Callender's Cables, Ltd..... 43
British Railways..... 15
British Rolling Mills, Ltd..... 62
Broom & Wade, Ltd..... 32
Brotherhood, P., Ltd..... 64
Brown, D., Corporation (Sales), Ltd..... 46
Brown, Lenox & Co., Ltd..... 94
Brown, R. (Espedair Foundries), Ltd..... 58
Brownlie & Murray, Ltd..... 55
Bullows, A., & Sons, Ltd.....136
Burgess Products Co., Ltd..... 50
Bury Felt Manufacturing Co., Ltd..... 3
Butcher, H., & Co.....135
Butterley Co., Ltd.....Cover i

Callow, F. E. (Engineers), Ltd. 20
Cape Asbestos Co., Ltd.....120
Carr, C., Ltd..... 35
Carron Co..... 56
Central Electricity Generating Board.....124
Chance Bros., Ltd..... 26
Clark, G., & Sons (Hull), Ltd...102
Cleveland Bridge & Engineering Co., Ltd.....122
Clyde Crane & Booth, Ltd.....100
Clyde Crane & Engineering Co.100
Clydeside Machine Tool Co., Ltd..... 70
Cochran & Co., Annan, Ltd... 19
Cohen, G., Sons & Co., Ltd....123
Conveyor & Elevator Co. (1936), Ltd..... 16
Cort, R., & Son, Ltd.....36–37
Cowlishaw, Walker & Co., Ltd. 63
Cox & Danks, Ltd..... 16
Crofts (Engineers), Ltd.....30–31
Cross Manufacturing Co. (1938), Ltd.....113
Crossley-Premier Engines, Ltd. 98

D.J.P. Telephones, Ltd..... 39
Delapena & Son, Ltd..... 46
Deloro Stellite, Ltd.....110
Distington Engineering Co., Ltd..... 86
Dore, J., & Co., Ltd.....115
Douglas, Lawson & Co., Ltd...104

PAGE

Dowson & Mason, Ltd..... 16
Dustraction, Ltd..... 48

Eagle & Wrights (Gauges), Ltd. 55
Eagre Construction Co., Ltd.... 68
Eclipse Foundry & Engineering Co. (Dudley), Ltd..... 92
Electrical Power Engineering Co. (B'ham), Ltd..... 35
Electromagnets, Ltd..... 67
Elliott Bros. (London), Ltd.....103
Engineering, Marine, Welding and Nuclear Energy Exhibition..... 25
English Numbering Machines, Ltd.....104
Evode, Ltd..... 60

Farmer, L., & Sons.....135
Fase Manufacturing Co., Ltd.. 15
Fenner, J. H., & Co., Ltd.....105
Ferodo, Ltd.....112
Fibreglass, Ltd..... 17
Firth Brown Tools, Ltd..... 10
Foord, J., & Co.....135
Ford Motor Co., Ltd.....127
Fuller Electric, Ltd..... 24
Fuller, Horsey, Sons & Cassell135

Gear Grinding Co., Ltd..... 96
General Electric Co., Ltd..... 92
Gloucester Foundry, Ltd..... 91
Goodwin, R., & Sons (Engineers), Ltd.....125
Grafton Cranes, Ltd..... 23
Greening, N., & Sons, Ltd..... 55
Greenwood's Standard Gear Cutting Co., Ltd..... 25
Guest, Keen Iron & Steel Co., Ltd.....128

H.M.S.O.....131
Hall Bros. (West Bromwich), Ltd..... 20
Hall, J. & E., Ltd.....117
Hammelrath & Schwenzer.....136
Harvey, G. A., & Co. (London), Ltd..... 66
Harvey Ironworks, Ltd..... 63
Heatrae, Ltd..... 76
Highfield Gear & Engineering Co., Ltd..... 68

PAGE

Holcroft, T., & Sons, Ltd..... 70
Holmes, W. C., & Co., Ltd..... 27
Horne Engineering Co., Ltd....116
Hot Dip Galvanizers Association..... 15
Hunt Bros. (Oldbury), Ltd.....113

Ilford, Ltd..... 8
Imperial Chemical Industries, Ltd.....107
Ince Forge Co..... 67
Ironsides Lubricants, Ltd..... 48

Keelavite Hydraulics, Ltd. Cover iv
Keith Blackman, Ltd.....128
Kestner Evaporator & Engineering Co., Ltd..... 22
King, Geo. W., Ltd.....126
Klinger, R., Ltd..... 12
Knight, Frank & Rutley.....135

Lafarge Aluminous Cement Co., Ltd..... 73
Lamson Engineering Co., Ltd. 69
Lane, G., & Sons, Ltd..... 3
Lazarus, I., Ltd.....136
Lee & Wilkes, Ltd..... 23
Leeds & Bradford Boiler Co., Ltd.....125
Lewin Road Sweepers, Ltd..... 6
Leyland Motors, Ltd..... 40
Lincoln Electric Co., Ltd.....119
Londex, Ltd.....125
Loveridge, Ltd..... 67
Low, A., & Sons, Ltd.....106

McNeil, C., Ltd.....104
Main, A. & J., & Co., Ltd.....101
Marbaix, Gaston E., Ltd..... 25
Markland Scowcroft, Ltd..... 97
Martin, Black & Co. (Wire Ropes), Ltd..... 87
Mason, E. N., & Sons, Ltd.... 80
Mavor & Coulson, Ltd..... 38
Mercer, T., Ltd.....116
Metropolitan - Vickers Electrical Co., Ltd.....121
Midland Electric Manufacturing Co., Ltd..... 90
Midland Silicones, Ltd.....84–85

PAGE

Mirrlees Watson Co., Ltd..... 22
Mond Nickel Co., Ltd..... 72
Moss Gear Co., Ltd..... 56
Munro, R. W., Ltd..... 16

National Steel Foundry (1914), Ltd 127
Negretti & Zambra, Ltd 49
Niagara Screens (Great Britain), Ltd..... 56
Norris Bros., Ltd..... 25

Parsons, C. A., & Co., Ltd..... 42
Paterson Engineering Co., Ltd. 72
Payne & Griffiths, Ltd..... 91
Perry Barr Metal Co., Ltd.....109
Phillips, J. W. & C. J., Ltd..... 63
Phœnix-Rheinrohr A.G..... 64
Pinchin, Johnson & Co..... 91
Pitman, Sir Isaac, & Sons, Ltd.131
Pollard Bearings, Ltd.....Cover iii
Pratt Bros. (Stourbridge), Ltd. 39
Progress (Universal), Ltd..... 47

Radiovisor Parent, Ltd.....113
Rayner, P., Ltd..... 69
Reavell & Co., Ltd..... 20
Reed Crane & Hoist Co., Ltd. 14
Renold Chains, Ltd..... 29
Research Engineers, Ltd..... 39
Reyrolle, A., & Co., Ltd..... 45
Rhodes, J., & Sons, Ltd..... 19
Richards & Partners.....135
Rivlink Belts, Ltd.....104
Roberts, J. W., Ltd..... 34
Robertson & Ferguson, Ltd..... 5
Robson, G., & Co. (Conveyors), Ltd..... 58
Rotherham & Sons, Ltd..... 25
Rotork Engineering Co., Ltd.....39–79
Russ-Elektroofen, Kg..... 71
Ruston-Bucyrus, Ltd.....114

S.M. Precision Spinning Co., Ltd..... 52
Sadi Engineering Co., Ltd..... 70
St. Georges Engineers, Ltd..... 47
Saunders Valve Co., Ltd..... 23
Schieldrop & Co., Ltd.....113
Scottish Machine Tool Corporation, Ltd..... 48
Shell-Mex & B.P., Ltd.....88–89

PAGE

Simon-Carves, Ltd..... 54
Simon Handling Engineers, Ltd..... 65
Skerne Works, Ltd..... 69
Slick Brands, Ltd.....116
Smedley Bros., Ltd..... 67
Smith & Grace, Ltd.....103
Smith, T., & Sons (Rodley), Ltd.....Cover ii
Stanweld Engineering Co., Ltd. 51
Steel Company of Scotland, Ltd..... 58
Steel Company of Wales, Ltd.. 78
Steels Engineering Products, Ltd..... 44
Stothert & Pitt, Ltd..... 53
Superwelds (Lewisham), Ltd.... 92
Sutcliffe, R., Ltd..... 83

Tangyes, Ltd..... 2
Taylor & Hubbard, Ltd..... 26
Teale, J. W., Ltd..... 63
Thornton, B., Ltd..... 67
Tilghman's, Ltd..... 74

United Dominions Trust, Ltd...107
United Filters & Engineering, Ltd.....101
United Wire Works, Ltd..... 7

V.W. Co., Ltd.....137
Vaughan Crane Co., Ltd..... 77
Vaughan, E., & Co., Ltd..... 14

Ward, T. W., Ltd.....28–134
Warne, Wright & Rowland, Ltd..... 18
Wellman Bibby Co., Ltd..... 6
Wellman Smith Owen Engineering Corporation, Ltd..... 37
Wells, A. C., & Co., Ltd..... 58
Westinghouse Brake & Signal Co., Ltd..... 52
Westwood, J., & Co., Ltd.....116
Wharton Crane & Hoist Co., Ltd..... 93
Wheatley, Kirk, Price & Co....135
White, R., & Sons (Engineers), Ltd..... 34
Wiley, J., & Sons, Ltd..... 47
Windley Bros., Ltd..... 39
Wright, Bindley & Gell, Ltd... 103

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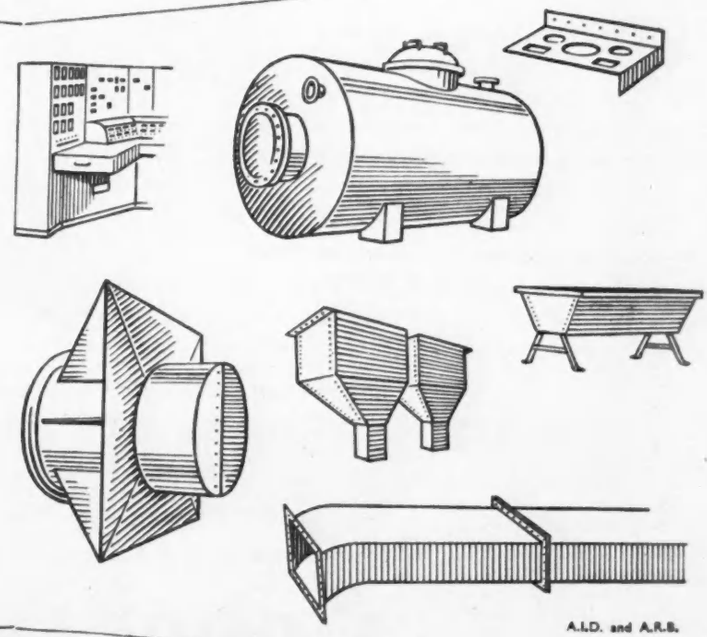

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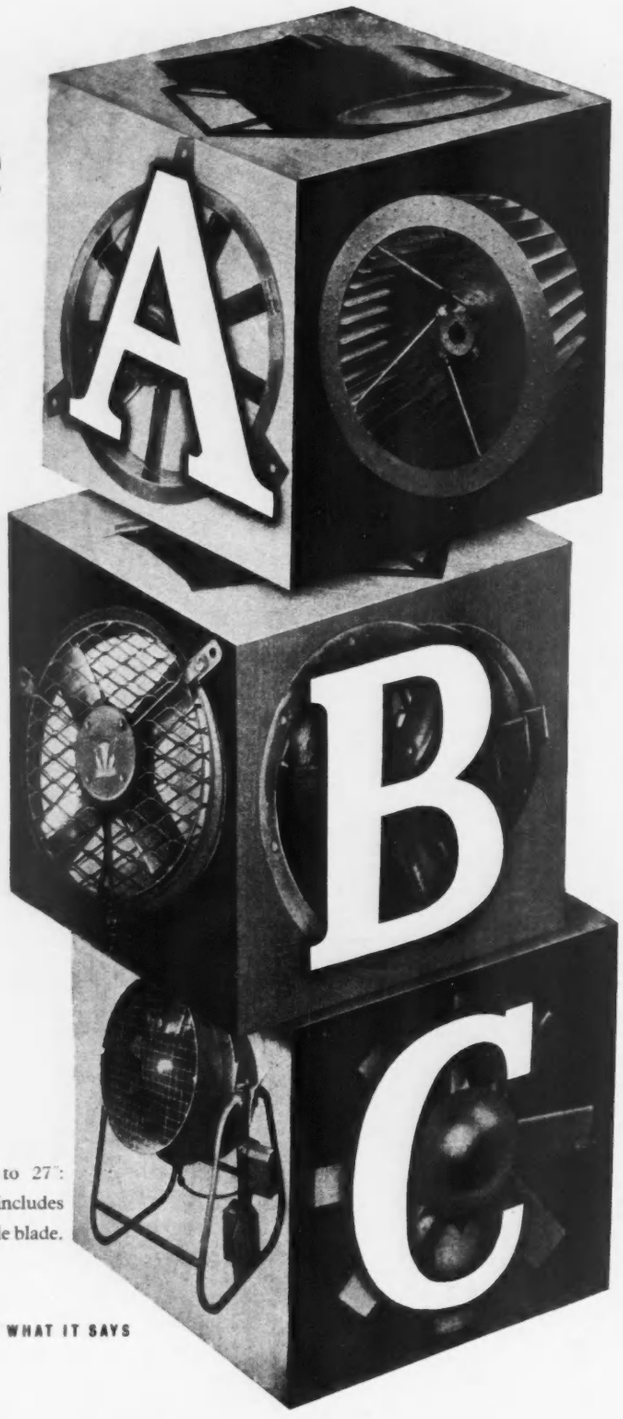

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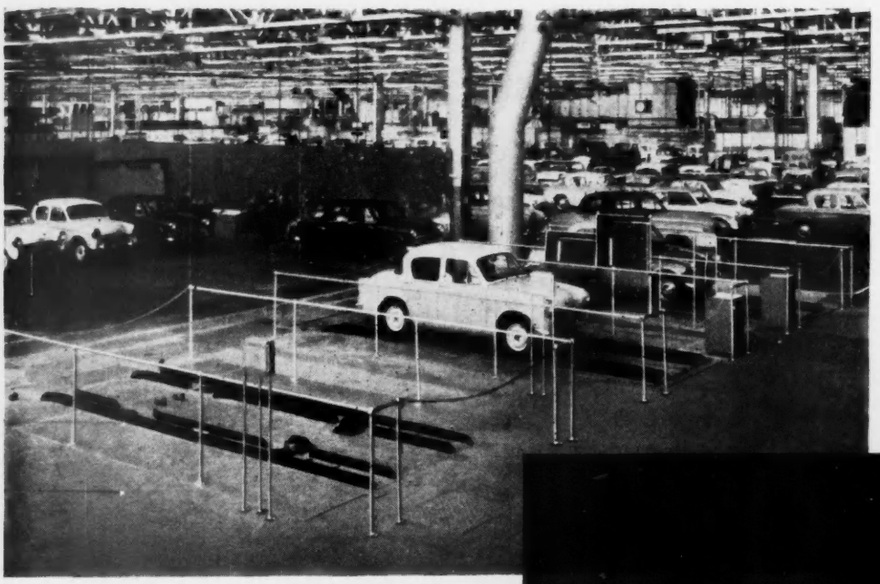

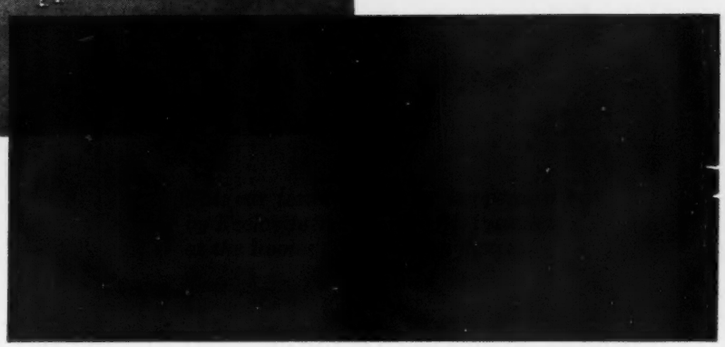

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